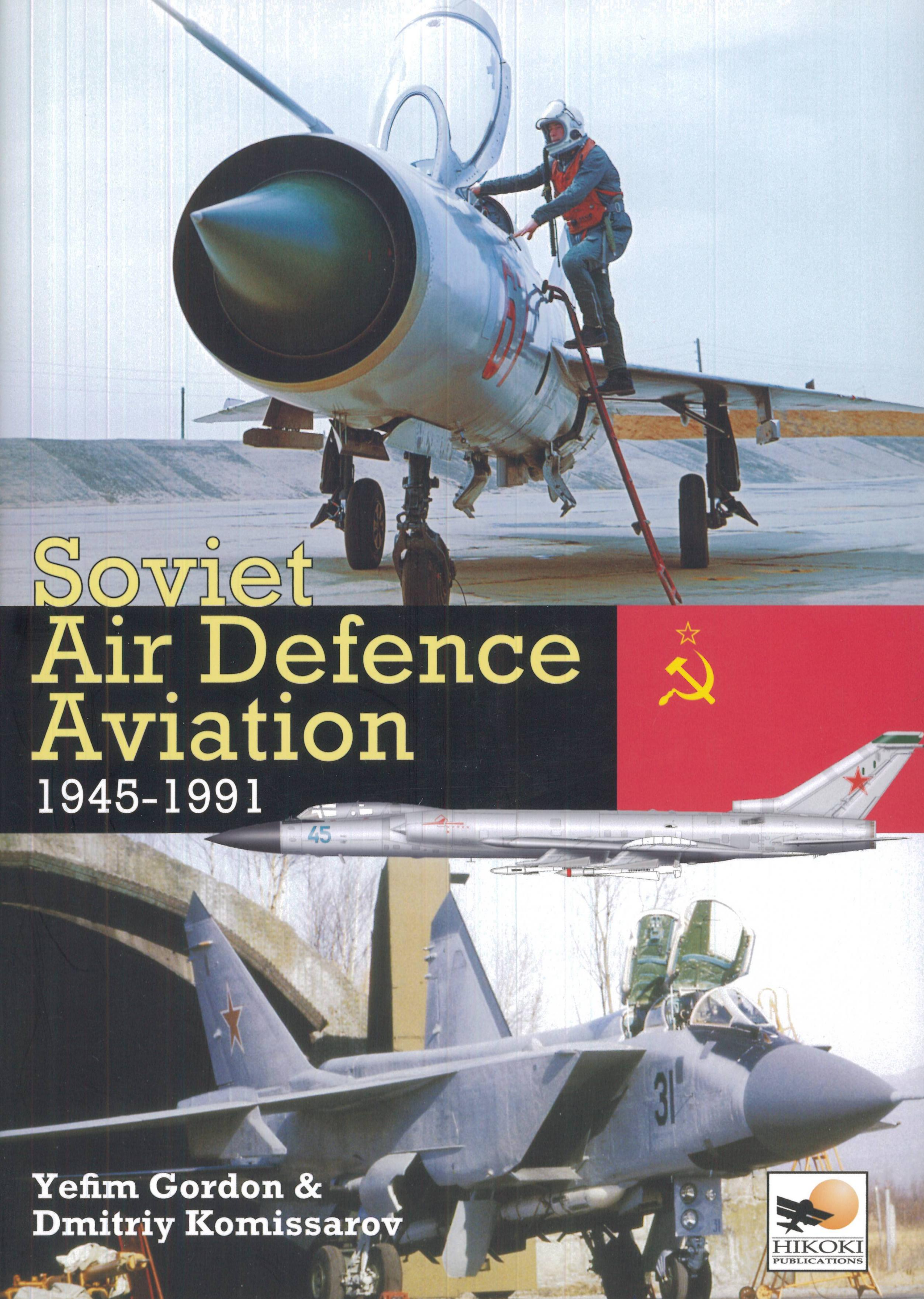

Soviet Air Defence Aviation

1945-1991

Yefim Gordon &
Dmitriy Komissarov

HIKOKI PUBLICATIONS

As early as May 1945, when hostilities in the Second World War had not yet ended, US Air Force aircraft began making reconnaissance flights in the Soviet Far East. Such missions with incursions into Soviet airspace were particularly intensive over areas such as the Kamchatka Peninsula, the Bering Strait and the Kurile Islands. The US command's excuse for such incidents usually was that the war with Japan was still going on and that navigation errors could occur. 27 such incidents were recorded between May and September 1945 involving 86 assorted aircraft.

In the immediate post-war years the Soviet PVO was not always able to prevent such incursions, and in several cases the spy planes got away unscathed. Yet, even in those early days Soviet fighter pilots could successfully intercept and destroy the intruders.

In the 1950s, when the Korean War had ended and the IA PVO had re-equipped from day fighters to all-weather interceptors, US reconnaissance aircraft ventured into Soviet airspace less frequently. The situation changed when the USAF introduced the Lockheed U-2 high-altitude spy plane, which contemporary Soviet fighters could not reach.

The service entry of the Su-15 and especially the MiG-25 led the USA to develop the Lockheed SR-71 Blackbird Mach 3 reconnaissance aircraft – which the Soviet Union countered by developing the MiG-31. The *Foxhound* effectively put an end to incursions by US aircraft however, occasional incursions by civil aircraft also occurred.

By the 1980s the Soviet PVO's fighter arm was at the peak of its strength and at the end of 1991, when the Soviet Union disintegrated, the IA PVO fleet included over 2,200 interceptors.

Soviet Air Defence provides a detailed history of this Cold War period and tells the fascinating story of the developments required to maintain privacy.

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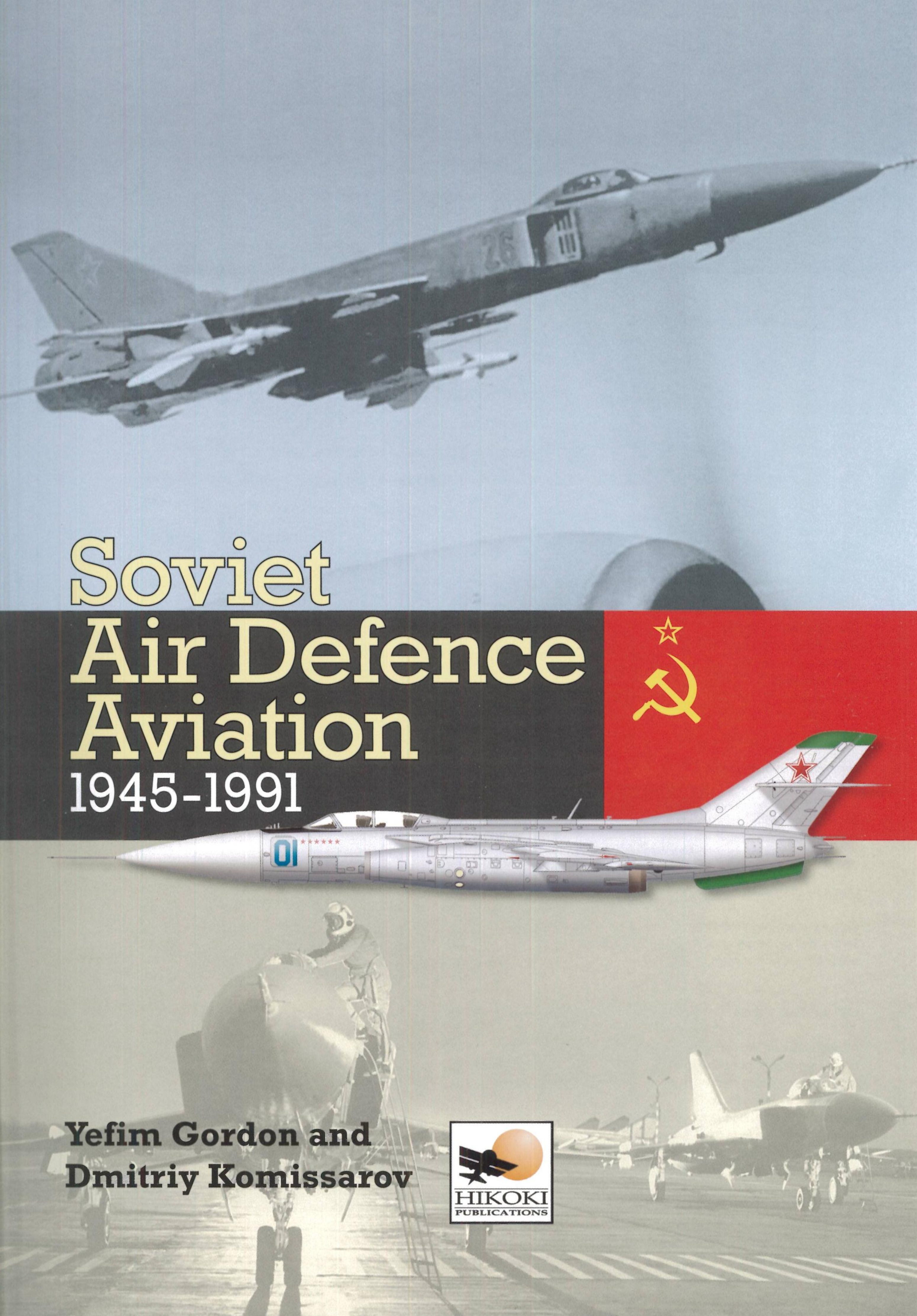

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Acknowledgements

Previous page: A MiG-19PM with a full load of RS-2-U missiles.

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An atmospheric sunset shot of a Su-27P carrying four R-27s, two R-73s and two ECM pods.

Introduction

In the Soviet Union the Air Defence (PVO – ***Pro****tivovoz****doosh****naya obo****ron****a*) Aviation was established as a specialised armed service during the Great Patriotic War of 1941-45; its original function was to defend key objectives (political and industrial centres in Soviet-held territory) against bombing raids and reconnaissance flights by the German Luftwaffe. After the war it became one of the principal arms of the Soviet national air defence. In the post-war years the PVO Aviation comprised the fighter branch (IA PVO – *Istre****bit****el'naya avi****aht****siya* ***Pro****tivovoz****doosh****noy obo****ron****y*), which was its principal component, as well as special mission aviation and transport aviation units. The mission of the IA PVO was to intercept and destroy hostile aerial vehicles (manned aircraft, reconnaissance drones, cruise missiles and drifting balloons) well before they reached the objective being defended. Its primary units were fighter regiments (equivalent to fighter wings, in USAF terms). Up to the late 1970s these regiments were organised into fighter divisions (equivalent to fighter groups) which, in turn, were organised into fighter corps or even fighter air armies (equivalent to air forces, in USAF terms). Later, however, as the regiments re-equipped with more modern hardware, they came under the direct control of the PVO formations; this was a result of the trend towards streamlining the chain of command. After this, each PVO formation (army, corps or division) had both fighter units, surface-to-air missile (SAM) units and radar units of its own. The IA PVO performed its functions jointly with other air defence assets, and often in close co-operation with the Soviet Air Force's fighter aviation. The PVO Aviation's special mission and transport components had an auxiliary function, supporting the operations of the IA PVO and the Air Defence Force's SAM and radar units. They consisted of independent (that is, direct reporting) air regiments or squadrons operating transport aircraft, special mission aircraft and helicopters.

Actually, an air defence aviation component had existed *before* the October 1917 revolution in the Imperial Air Fleet (IVF – *Impe****rah****torskiy voz****doosh****nyy flot*, the pre-revolutionary Russian Air Force). Its birth and development had been dictated by the general trends in the development of aviation and of the forms of its combat use. During the First World War a considerable proportion of the belligerents' fighter fleets was assigned to defending major political and industrial centres; this created the prerequisites for the birth of the specialised air defence aviation. In 1916 an independent air division comprising three air detachments, with six fighters each, was formed within the IVF for protecting the city then known as Petrograd (the excessively German-sounding original name St. Petersburg had been relinquished after the outbreak of the war with Germany). At the time the leading nations of Western Europe were working on new tactics and techniques of providing air cover for objectives on the ground and waging aerial combat for the purpose of foiling air strikes against these objectives. The first steps had been taken to organise concerted action of fighters and other air defence assets.

After the revolution, in early 1918, the first air detachments of Soviet Russia were formed in Petrograd in accordance with the decree establishing the Workers' and Peasants' Red Army. Within a short time, air cover of the city by 19 fighters had been organised to prevent attacks by the counter-revolutionary White armies. At about the same time similar air detachments were formed to protect Moscow, Kronshtadt (a fortress near Petrograd) and Tula. In 1925, shortly after the formation of the Union of Soviet Socialist Republics, the government passed a special directive to bolster the air defence of major Soviet cities and other objectives of national importance. Concurrently, in 1925-30, the Red Army Air Force began taking delivery of the first Soviet-designed fighters – the I-2 developed by Dmitriy P. Grigorovich, the I-3 and I-5 developed by Nikolay N. Polikarpov and the I-4 developed by Pavel O. Sukhoi (who at the time was an aide to Andrey N. Tupolev). These biplanes were armed with 7.62-mm (.30 calibre) machine-guns; their performance included a speed of 220-280 km/h (136-174 mph) and a service ceiling of up to 7,500 m (24,610 ft). In 1933-39 the air defence units were equipped with Polikarpov fighters – the I-15, I-15*bis* and I-153 biplanes (the latter model had a retractable landing gear) and the I-16 monoplane. These were more capable fighters, with a top speed of 370-490 km/h (229-292 mph) and a service ceiling of up to 10,700 m (35,100 ft); they also packed a bigger punch, being armed with 12.7-mm (.50 calibre) machine-guns, 20-mm (.78 calibre) cannons and 82-mm (3.22-in) RS-82 unguided rockets. In 1940 the IA PVO units began re-equipping with the new Yak-1 fighter designed by Aleksandr S. Yakovlev and the MiG-3 interceptor designed by Artyom I. Mikoyan and Mikhail I. Gurevich, with a top speed of 580 km/h (360 mph) and 615 km/h (382 mph) respectively. Meanwhile, the air defence aviation's order

A Yak-25MG interceptor with partially open canopy is inspected before flight.

of battle, combat tactics and methods of co-operation with other air defence assets were progressively refined. According to plans, objectives in the rear area would be protected by specially-assigned IA PVO units along with anti-aircraft artillery units (and associated searchlight units) and barrage balloons.

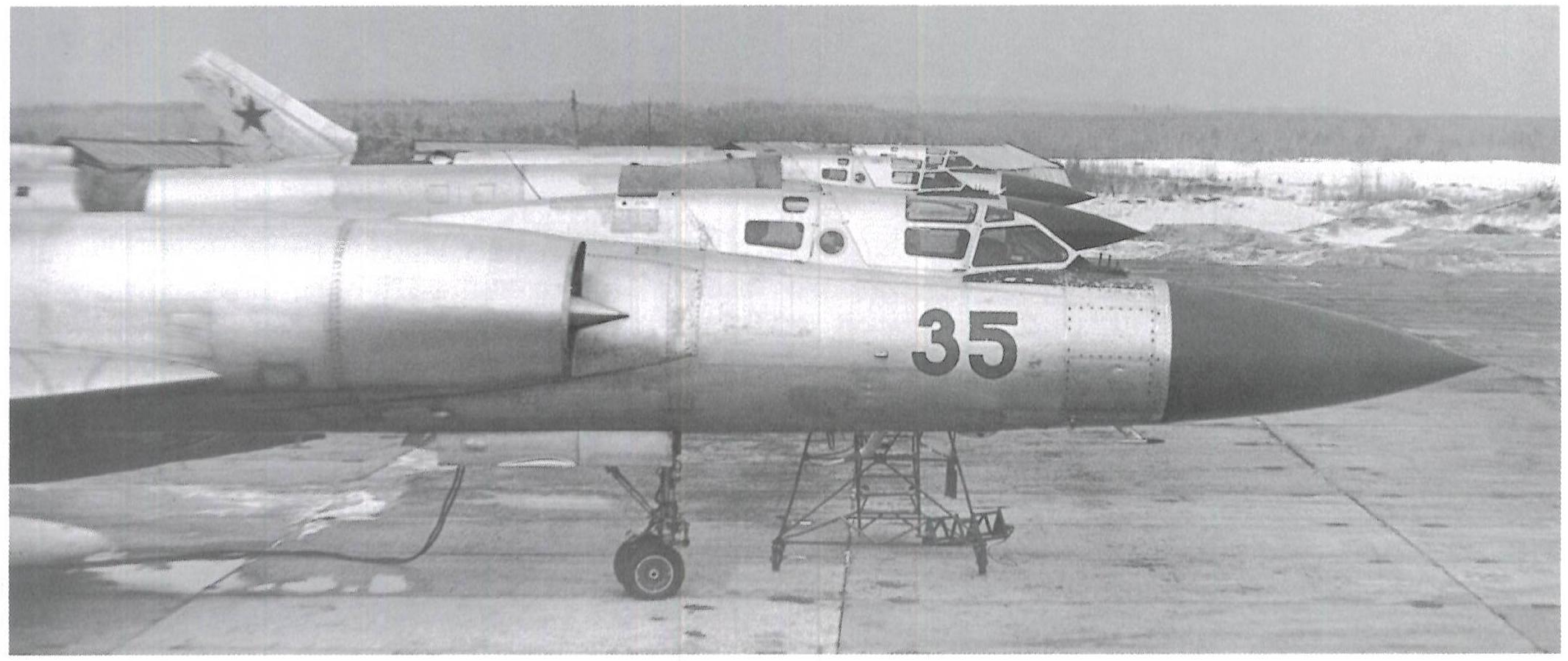
Until the outbreak of the Great Patriotic War on 22nd June 1941 all Soviet fighter units and formations were organisationally part of the Red Army Air Force – albeit some of them were earmarked for point air defence duties. As of 1935, a total of 29 squadrons with more than 900 fighters on strength were assigned to protecting major cities. By the time the war broke out on 22nd June 1941 the Red Army Air Force included 40 air defence fighter regiments numbering some 1,500 aircraft. Of these, 11 fighter regiments with 602 aircraft were assigned to defending Moscow. Leningrad was protected by nine regiments, as was Baku; Kiev had four fighter regiments, while Riga, Minsk, Odessa, Krivoy Rog and Tbilisi had one each. A further two regiments were stationed in the Soviet Far East. All of the abovementioned 40 regiments were transferred to the Air Defence Force in January 1942, thereby marking the birth of a new armed service – the PVO Aviation.

In the course of the Great Patriotic War the IA PVO renewed its aircraft fleet completely. The Air Defence Force regiments re-equipped both with new indigenous fighter types (the Lavochkin La-5 and La-7, the Yakovlev Yak-7, Yak-9 and Yak-3) and with imported aircraft supplied under the Lend-Lease agreement (the Hawker Hurricane Mk II, the Supermarine Spitfire Mk V, the Curtiss P-40C Tomahawk and P-40K/P-40N Kittyhawk, the Bell P-39 Airacobra and P-63A/P-63C Kingcobra). All of them had potent cannon armament and a top speed of 600-720 km/h (372-447 mph).

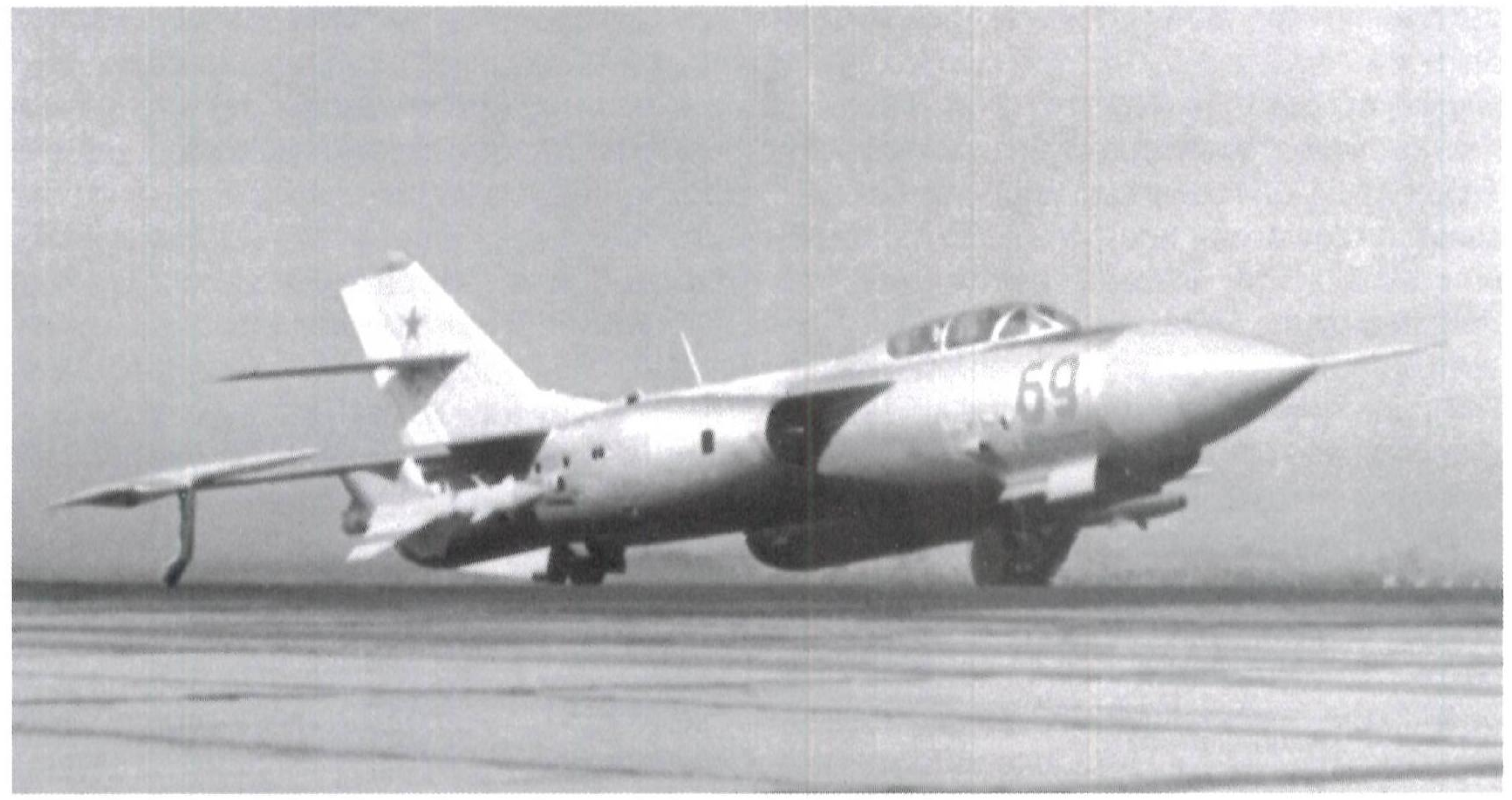
In the pre-war years and at the opening stage of the war the equipment standard of Soviet fighters left a lot to be desired; in particular, many fighters lacked communications equipment (!). From 1944 onwards, however, almost all IA PVO aircraft were equipped with two-way radios, making ground-controlled intercept possible if air defence radars were used.

Towards the end of the war the Air Defence Aviation forces fighting on four PVO Fronts in Europe (Western, South-Western, Central and Transcaucasian) and stationed in the Far East comprised one PVO fighter army, four PVO fighter corps and 24 PVO fighter divisions operating close to 3,200 aircraft between them. The 1st PVO Fighter Army consisted of one fighter corps defending Leningrad, three fighter divisions defending Moscow and one fighter division each in Murmansk, Arkhangel'sk and Gor'kiy. As of 1st May 1945 the IA PVO had a total of 97 fighter regiments.

In the course of the Great Patriotic War the fighter pilots of the IA PVO shot down 3,930 Luftwaffe aircraft and destroyed another 238 on the ground. 17 IA PVO units and formations gained the prestigious Guards title awarded for extra gallantry in combat; seven units were awarded government orders. 95 IA PVO pilots earned the prestigious Hero of the Soviet Union (HSU) title for exceptional bravery and heroism in combat; Capt. A. T. Karpov, who fought in the 2nd GvIAK (*Gvar**dey**skiy istre**bit**el'nyy aviatsi**on**nyy **kor**pus* – Guards Fighter Corps), even became twice HSU.



The Tu-128 heavy interceptor was the PVO's most potent fighter type in its day.



An early Yak-28P interceptor armed with two R-98 AAMs.

Though mostly operated by the Air Force, the MiG-21PF was also used for national air defence tasks.

During the war the IA PVO lost 1,588 aircraft and 724 pilots to enemy action. Thus, the kill-to-loss ratio was 1 to 2.5 in favour of the Soviet pilots.

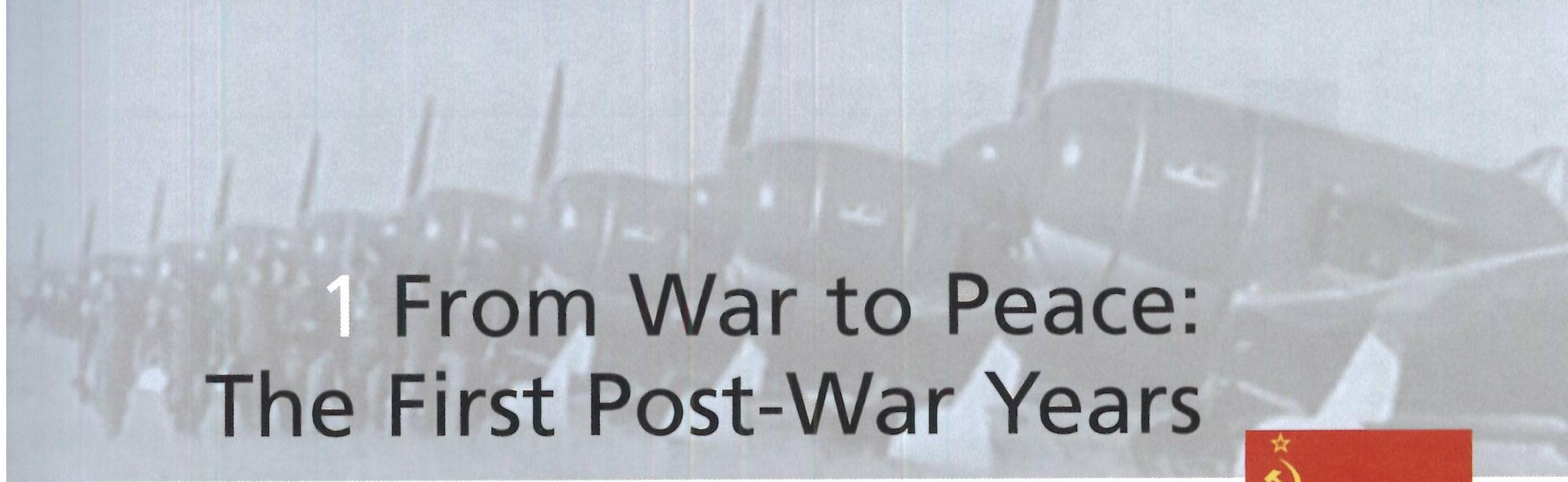
In the immediate post-war years the IA PVO started re-equipping with jet aircraft. The first of these were the Mikoyan/Gurevich MiG-9 (NATO reporting name *Fargo*) and Yakovlev Yak-15 *Feather* first-generation jet fighters, which were built and operated on a small scale in the late 1940s. In the 1950s these were superseded by the swept-wing second-generation MiG-15 *Fagot*, MiG-17 *Fresco*, MiG-19 *Farmer* and Yak-25 *Flashlight-A*, including versions tailored to PVO requirements which were equipped with aerial intercept (AI) radars to give all-weather capability and sometimes armed with air-to-air missiles (AAMs). In the 1960s the Air Defence Force fielded the Sukhoi Su-9 *Fishpot-B*, Su-11 *Fishpot-C*, Su-15 *Flagon-A*, Su-15T *Flagon-E* and Yakovlev Yak-28P *Firebar* supersonic interceptors and the Tupolev Tu-128 *Fiddler* heavy supersonic interceptor. Additionally, the MiG-21PF *Fishbed-D* and MiG-21PFM *Fishbed-F* light interceptors operated by the Soviet Air Force's tactical aviation branch (FA – *Fronto**va**ya avi**ah**tsiya*, lit. Front-line Aviation) also fulfilled the air defence role. In the 1970s and 1980s the PVO's fighter units were equipped with the MiG-23M *Flogger-B* and MiG-23MLD *Flogger-K* 'swing-wing' third-generation fighters, the MiG-23P *Flogger-G* interceptor version, the MiG-25P *Foxbat-A* Mach 3 interceptor (and subsequently the upgraded MiG-25PD/MiG-25PDS), and the improved Su-15TM *Flagon-F* interceptor. In the final years of the Soviet Union's existence these were being supplanted by the Su-27P *Flanker-B* fourth-generation interceptor and the MiG-31 *Foxhound* long-range interceptor. Thanks to a top speed of up to 3,000 km/h (1,863 mph), a service ceiling in excess of 20,000 m (65,620 ft) and up-to-date weapons the aircraft of the Soviet Air Defence Force were capable of intercepting any targets, including stealthy, small and/or low-flying aerial vehicles, in any weather and any time of day.

In the 1970s the Soviet PVO received its first airborne early warning and control (AEW&C) system – the Tupolev Tu-126 *Moss*. The interceptors' weapons arsenal was expanded by adding the new R-4, R-23, R-40 and R-98 medium-range AAMs and, shortly afterwards, the highly effective R-60 short-range AAM. In the final years of the Soviet Union's existence the fourth-generation interceptors were armed with more effective R-27 medium-range AAMs and R-33 long-range AAMs. The PVO Aviation's battle tactics, including methods of co-operation with the SAM units, also evolved over the years.

During the 45 post-war years leading up to the demise of the Soviet Union (commonly known as the Cold War era) the PVO Aviation maintained a 24-hour, seven-days-a-week vigil, protecting the nation's borders. Within this time frame, hundreds of suspicious aircraft had been intercepted and dozens had been destroyed (when confirmed as being hostile). In several cases the intercepts involved ramming attacks as a last resort, and the fighter pilots who performed them received top government awards – sometimes posthumously. Several cases when Western civil airliners strayed into Soviet airspace, whether accidentally or on purpose, and were intercepted have triggered major diplomatic scandals and sparked vicious debate in the press that lasted for years. The Soviet interceptor pilots felt the sizzling tension between the East and the West like none other as they sat in the cockpits of their aircraft on quick-reaction alert at numerous airbases throughout the world's largest country. It was largely thanks to them that the ordinary Soviet citizens could 'sleep tight', assured that no aggression against their homeland would ever take place again.

During the post-war period the IA PVO was successively commanded by Col.-Gen. Ivan D. Klimov, Lt.-Gen. Serafim A. Pestov, Col.-Gen. Yevgeniy Ya. Savitskiy (who later became the sole IA PVO Commander to be promoted to Air Marshal), Lt.-Gen. Mikhail G. Machin, Lt.-Gen. Anatoliy L. Kadomtsev, Col.-Gen. Andrey Ye. Borovykh, Col.-Gen. Nikolay I. Moskvitelev, Col.-Gen. Vladimir I. Andreyev and Lt.-Gen. Oleg V. Anisimov. Special mention should be made of the contribution made to the development of the IA PVO by distinguished military pilots Air Marshal Yevgeniy Ya. Savitskiy (who had earned two HSU titles in the war), Lt.-Gen. Anatoliy L. Kadomtsev (who was tragically killed in the crash of a MiG-25P during the type's service induction) and Col.-Gen. Nikolay I. Moskvitelev. When the latter was Commander, the IA PVO units not only started operating many new fighter types but also mastered new techniques of beyond visual range (BVR) missile attack.

The Soviet Air Defence Force's fighter branch has a long and fascinating history with which the authors would like to acquaint the readers. This book deals with the post-war period of the IA PVO story.



1 From War to Peace: The First Post-War Years

After the termination of hostilities in the Second World War the Soviet Union began a cutback of its air defence force, reorganising it at the same time, due to the perceived reduction of the threat (a belief soon proven to be wrong). The wartime PVO Fronts gave way to PVO Districts (by analogy with the Military Districts into which the Soviet Army and the Air Force were organised). The two PVO Districts exercised control over two PVO fighter air armies, which comprised three air corps, 24 air divisions, 83 air regiments and 56 ground support battalions at the airbases. By April 1946 the Air Defence Force's aircraft fleet consisted of 5,412 aircraft – 1,706 Soviet-built fighters, 2,961 imported fighters (P-39s, P-63s and Spitfires), 72 Douglas A-20G Havoc bombers retrofitted with Soviet-made AI radars for use as night fighters and 673 other aircraft.

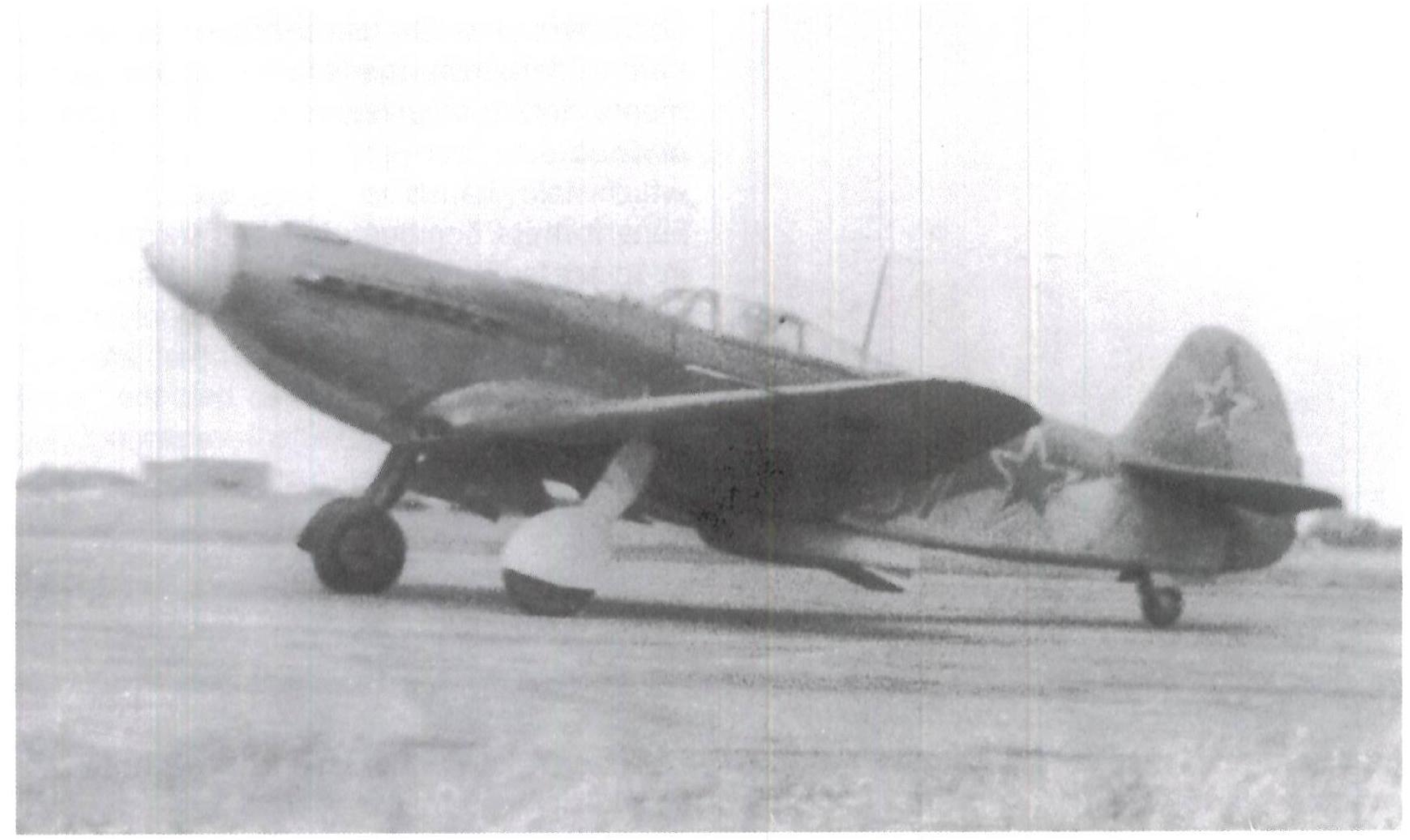
In 1948 the Air Defence Force underwent another reform. The PVO Districts were abolished and several PVO Regions were established nationwide; these were divided into three categories. As a rule, in Category 1 regions the IA PVO was organised into PVO fighter air armies as the top echelon; in Category 2 regions the air corps or air division was the top echelon, while Category 3 regions might have no fighter aviation at all. By 1st September 1948 the IA PVO aircraft fleet had shrunk to 1,909 aircraft. By then the Air Defence Force was fielding its first jets – the MiG-9 and the Yak-15. In 1947-48 the IA PVO was commanded by Lt.-Gen. Serafim A. Pestov.

The advent of the first Soviet jets made it imperative to establish a special operational conversion unit (OCU) which would help the technical staff and the aircrews to master the new hardware. In August 1946 the personnel of the independent training air regiment (UTAP – *oo**chebno**-treni**rov**ochnyy **avia**polk*) based at Savasleyka airfield near the city of Gor'kiy (now renamed back to Nizhniy Novgorod) started getting to grips with the Yak-15 – the first Soviet jet fighter to reach production. Col. P. S. Akoolenko, Col. I. Ye. Abramov, Maj. I. D. Koshel', Maj. Kuz'minskiy and Capt. Ye. A. Zyryanov were the unit's first pilots to gain their Yak-15 type rating. In December 1946 eleven UTAP pilots made a flight from Moscow to Gor'kiy in the newly-received Yak-17 *Feather*

Previous page: Bell P-63A Kingcobra fighters remained in PVO service in the immediate post-war years.

A Yak-9U fighter in service with the PVO. The aerial mast identifies the aircraft as a post-war machine built in 1946 or later.

A Yak-9U in post-war grey colours



A post-war production Yak-9U in dark camouflage with pale blue undersurfaces.

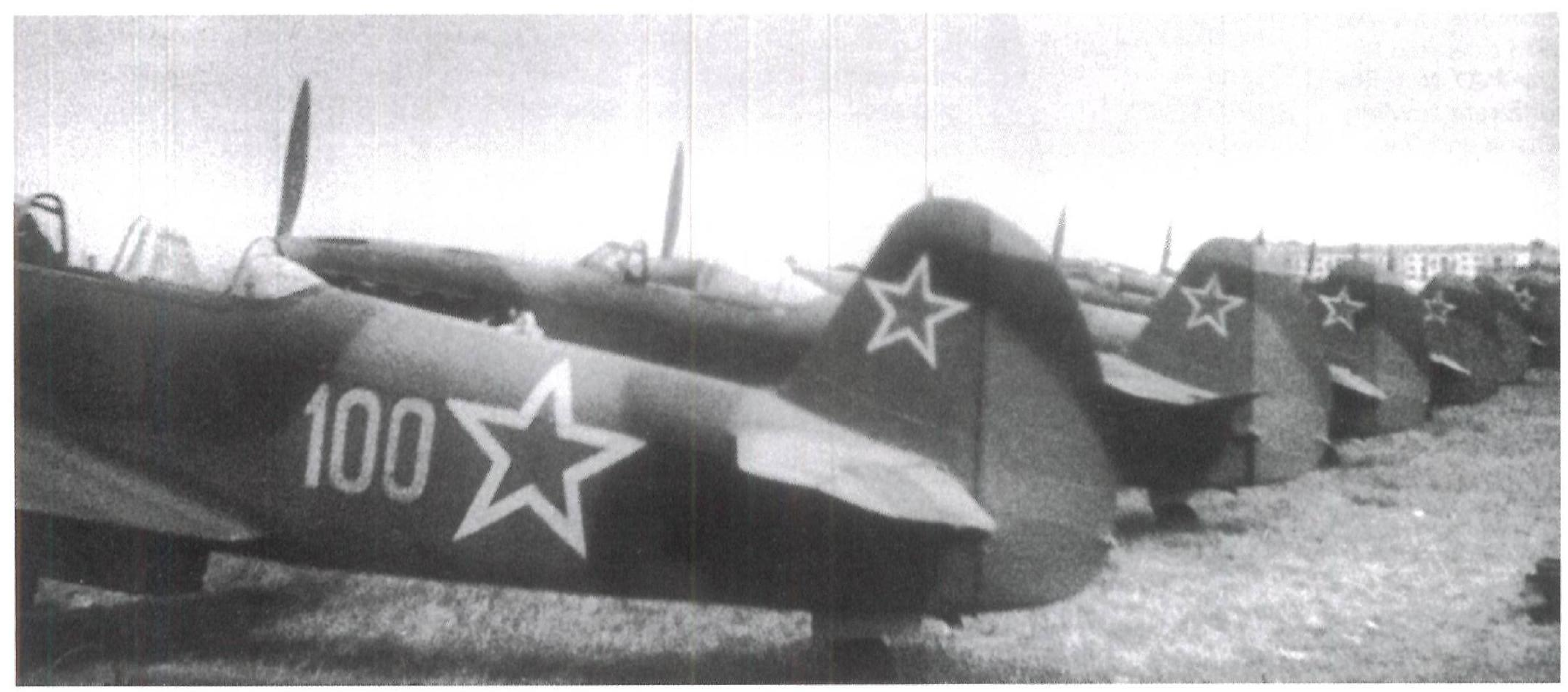
fighters. In 1947 the regiment started conversion training for the MiG-9 twinjet fighter.

On 20th February 1947 the UTAP was reorganised as the PVO Aviation's Training & Methodical Centre awarded the Red Banner Order. Being, as it were, the most experienced Soviet jet pilots, the Centre's airmen were often called upon to make flypasts on various festive occasions. In 1948 they achieved a 'world first' by performing the first-ever group jet aerobatics (by a five-ship formation) during the traditional Aviation Day air event at Moscow-Tushino airfield. On that occasion the fighters were flown by Lt.-Col. N. Khramov, Lt.-Col. P. Sereda, Maj.-Gen. Yevgeniy Savitskiy (who subsequently became Commander of the IA PVO), Col. V. Yefremov and Maj. L. Solov'yov. In due course the service pilots of the IA PVO mastered the Yak-15, Yak-17, MiG-9 and Lavochkin La-15 *Fantail* fighters at Savasleyka, returning to their units after completing the training course.

Despite the mounting deliveries of jet fighters, the vast majority of the Soviet Air Force and IA PVO fighter units were still equipped with piston-engined aircraft – the Yak-9 *Frank*, La-7 *Fin*, La-9 *Fritz*, La-11 *Fang*, P-39 and P-63 *Fred* – in those days.

Regrettably, hardly had the Soviet Union emerged victorious from a four-year war of attrition against Germany in Europe and Japan in the Far East than its wartime allies in the anti-Hitler coalition turned new adversaries. The confrontation between the two super-

Yak-9Us on the unpaved flight line of a Soviet airfield in the late 1940s.



The La-9 saw service with the IA PVO in the 1940s. The nine aircraft shown here have gained a red special colour scheme for an air parade.

powers – the Soviet Union and the USA – that began immediately after the Second World War intensified, becoming known as the 'Cold War' that lasted nearly 45 years.

During the 'Cold War' years the Soviet Union and the western world alike kept developing new types of weapons, commissioning new defence industry plants, airbases and test ranges. That said, aerial reconnaissance became a widespread method of intelligence gathering; the US reconnaissance aviation was particularly active in its efforts to detect hitherto unknown military installations in Soviet territory. Such missions, which began before 1950 and continued throughout the Cold War, were known as the Peacetime Airborne Reconnaissance Program, or PARPRO.

Even before the surrender of Japan in August 1945, US Army Air Force aircraft repeatedly intruded into Soviet airspace. The US command usually cited pilot error (navigational errors) as the cause. Even today, it is hard to determine the veracity of these statements. Yet, in a curious way, these incursions undoubtedly benefited the Soviet Union, which laid hands on three Boeing B-29 Superfortress bombers that had force-landed in Soviet territory and thus came into possession of the latest technology not only in aircraft design but also in some other areas of military technology. Thanks to this, the Soviet aircraft industry was able to reverse-engineer the B-29 in record time – just a few years – and put it into production as the Tupolev Tu-4 *Bull*, the Soviet copy being a faithful reproduction of the original and thus equalling it in performance. For the Soviet Union it was imperative to develop and field, in timely fashion, a bomber capable of delivering the Soviet nuclear bomb which had already been created by then (incidentally, again with assistance from US citizens whose services had been enlisted by the Soviet intelligence agency).

Even though the USA made such strategic 'gifts' (against its will) to its erstwhile ally, this did not put the Americans off the idea of making further reconnaissance flights over the Soviet Union. US Army Air Force spyplanes started patrolling the Soviet borders on a regular basis almost immediately after the cessation of hostilities in the Second World War. The first of these were Boeing B-17 Flying Fortress strategic bombers converted into 'ferret aircraft'; several B-17s outfitted with signals intelligence (SIGINT) equipment were used to pinpoint the first Soviet air defence radars and determine their parameters. The B-17's long range and endurance allowed it to loiter near

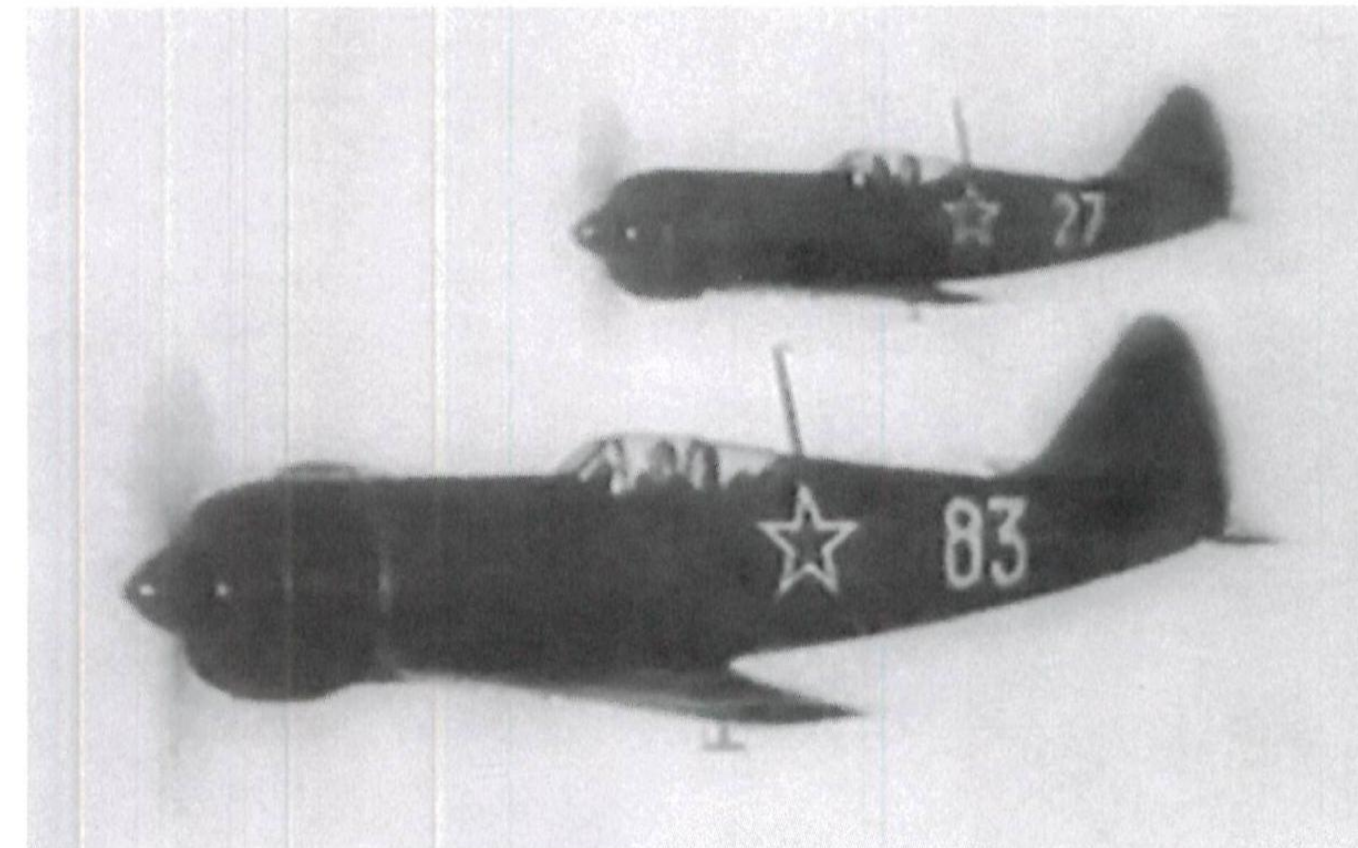
The La-11 evolved from the La-9 was also operated by the PVO. Note the different cowling shape and the Cyrillic 'Ла-11' nose titles.

the Soviet borders for an extended time, picking up the pulses of the borderside AD radars and determining their ability to detect targets. Occasionally the USAAF aircraft intruded into Soviet airspace (either accidentally or wilfully). Between May and September 1945 alone, 27 such border incidents involving 86 assorted US aircraft (mostly Consolidated B-24 Liberator and North American B-25 Mitchell bombers) were recorded. After the surrender of Japan and the end of the Second World War, at least 46 more border incursions involving 63 US aircraft took place up to the end of 1950; no fewer than 15 of these were recorded within less than a month (between 27th June and 16th July 1950).

The first air battle of the Cold War took place in the Far East as early as the second half of 1945, when a USAAF B-29 was forced down at a Soviet airbase. This was a time when both Soviet and American troops were temporarily stationed in Korea, which had just been liberated from Japanese occupation. A major Soviet airbase was located at Kanko (today the city is called Hamhung or Hamhung-si, and is North Korea's second-largest city and the capital of South Hamgyong Province). In contravention of a Soviet-US agreement, USAF aircraft would often overfly the base outside their assigned air route. For a while the Soviet command put up with this – the Americans were allies, after all. Soon, however, a high-ranking commission arriving from Moscow to inspect the troops ordered that measures be taken to stop the overflights.

Several accounts of the incident exist. According to one of them, one day in November 1945 a flight of four Soviet Air Force P-39s scrambled to intercept the American bomber and force it down at Kanko. At first the crew of the Superfortress ignored the orders to land, but had to comply soon enough when one of the fighters opened fire, setting one of the B-29's engines alight.

According to another account, the incident took place on 29th August 1945 near Kanko, which hosted the 14th IAP (*istre**bit**el'nyy **avi**-**a**polk* – fighter regiment) of the Pacific Fleet air arm. First, two Yak-9s flown by Lt. Feofanov (leader) and Lt. (JG) Zizevskiy (wingman) scrambled to intercept an American bomber flying at 400-500 m (1,310-1,640 ft); ten minutes later they were joined by a second pair of Yaks flown by Lt. Velik and Lt. (JG) Mdivani. It was Zizevskiy who opened fire of his own accord, whereupon the B-29 landed at Kanko with one engine on fire.



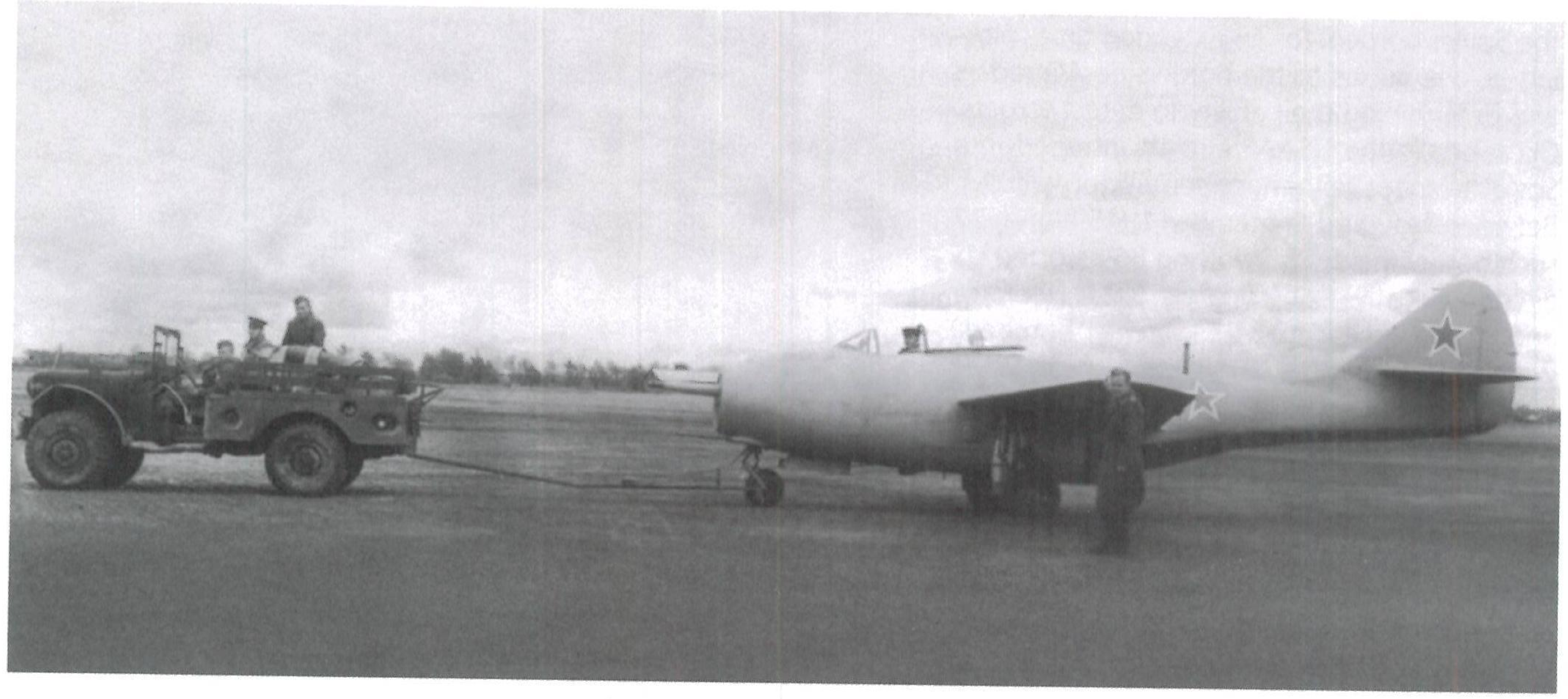
A pair of La-11s pictured during a sortie.

None of the American crewmen suffered any harm in the attack, as only the engine was targeted. The B-29 crew was interned; some sources claim the aircraft was delivered to Moscow for study and testing. It should be noted that the bomber did not return fire. When asked during the interrogation why they had not fired, the B-29 captain was frankly amazed: 'How could we fire at the Russians?'

On 15th October (some sources state 15th November) 1945 a US Navy Martin PBM-5 Mariner flying boat was attacked by a Soviet fighter 40 km (25 miles) south of Dairen (formerly Port Arthur), Manchuria, while on a routine patrol mission. No damage was inflicted. The PBM-5 was investigating six Soviet transport ships and a beached seaplane in the Gulf of Chihli in the Yellow Sea.

When the Soviet troops that had been deployed in Iranian Azerbaijan in connection with military hardware deliveries under the Lend-Lease agreement began pulling out in April 1946, the USA wished to keep a tab on the process. On 5th April two American aircraft crossed the Soviet-Iranian border near Astara, Azerbaijan, proceeding 6 km (3.7 miles) into Soviet airspace. The Soviet government lodged a formal protest with the US Embassy in Moscow; the recently appointed US Ambassador Walter Bedell Smith promised to look into the matter and assured the Soviet authorities that such incidents would not be repeated. It should be noted that neither side made any mention of the incident in the press so as to avoid a public scandal, since the Soviet Union and the USA were formally still allies.

Still, the border incursions continued. On 25th February 1947 an American spyplane crossed the Soviet border near Ratmanov Island in the Bering Strait; on 23rd December that year another incursion took place near



The MiG-9 was operated by the PVO in small numbers. Here a MiG-9 is towed by a Dodge WC-51 3/4-ton truck.

the Chukotka Peninsula in the Far East. Again, the Soviet Union filed formal protests, which bore fruit; the crews of US reconnaissance aircraft were instructed to maintain a certain standoff distance from the borders of the Soviet Union and the East European countries under Soviet control when flying their missions.

In 1947-48 there were also a number of cases when foreign aircraft intruded into Soviet airspace from Finland and Norway.

The situation on the Soviet Union's southern borders was more relaxed, but not altogether free from incursions, most of which took place in Azerbaijan (the intruders originated from Iran). On 27th March 1947 one such uninvited guest was apprehended. A single-engined propeller-driven aircraft belonging to the Imperial Iranian Air Force (IIAF) crossed the Soviet border 85 km (52.82 miles) east of Julfa, Nakhichevan' Autonomous Region, Azerbaijan (or, to use the Azerbaijani spelling, Culfa). After following the Araks River (which forms the border between Iran and Azerbaijan) for a while – on the wrong side of the border – the aircraft landed near Nakhichevan' (or, to use the Azerbaijani spelling, Naxçivan), whereupon the crew of two were detained by a Soviet Border Guards patrol arriving on the scene. During the interrogation the pilots, both of them IIAF officers, maintained that they had departed from Tehran, bound for Tabriz, and strayed into Soviet airspace after losing their bearings. While that may be true, it was established that the aircraft and its crew belonged to a reconnaissance unit based in Tehran, and the aircraft was armed on top of it all. Three more incursions by Iranian and American aircraft took place in the same area before the year was out.

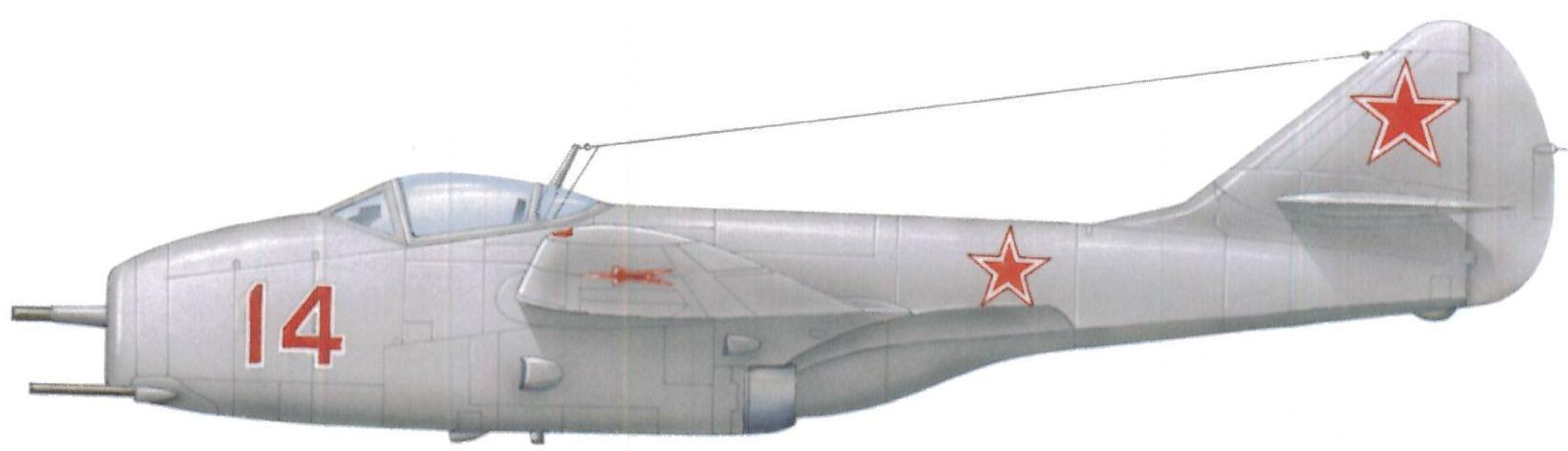
On 22nd October 1949 a US Air Force Boeing RB-29 Superfortress reconnaissance aircraft (known as the F-13A under the old USAF designation system) was attacked by Soviet fighters over the Sea of Japan but escaped. There were no injuries to the crew.

The growing Soviet military potential in the post-war years worried the US political and military establishment a good deal. Therefore aerial reconnaissance of Soviet air defence assets, airbases and naval bases, as well as defence industry facilities and weapons test ranges, became a top priority for the US intelligence community. Accordingly, the Soviet reaction became more resolute. Throughout 1949 and in early 1950 US reconnaissance aircraft approaching the Soviet borders were escorted by Soviet interceptors. For a while the latter did not shoot to kill but made it clear that they were on a 'make my day' footing and would fire if need arose. Thus, on 22nd October 1949 a pair of La-7 fighters made four passes at a Boeing RB-29 over Soviet territorial waters, firing warning shots as a 'friendly reminder' to leave the area on the double. The American press raised a cry of outrage, denouncing the actions of the Soviet fighters against the allegedly unarmed US aircraft. Yet, sober-minded western journalists, such as Walter Lippman, pointed out that 'the Soviets' were merely demonstrating their resolve and readiness to oppose US strategic air power.

The incident which took place on 8th April 1950 proved this point. That day a US Navy Consolidated PB4Y-2 Privateer patrol bomber (BuNo 59645) named 'Turbulent Turtle' and operated by Detachment A of the 26th Maritime Patrol Squadron (VP-26) took off from Wiesbaden, West Germany. Actually VP-26 was home-based at Naval Air Station Port Lyautey in French Morocco, using Wiesbaden as a forward operating location (FOL). The objective was to reconnoitre the Soviet Navy/Baltic Fleet base of Libava near Liepaja, Latvia. (Note: Libava, the third-largest city of Latvia, had been renamed Liepaja (pronounced ***Liy**epaya*) back in 1918, but the naval base had retained the old name for some reason.) US Navy Privateers had appeared in the area on several prior occasions, but on that day the spyplane fell into an ambush. A flight of four La-11 fighters from the 30th GvIAP (*Gvar**dey**skiy istre**bit**el'nyy **a**viapolk* – Guards fighter regiment) scrambled to intercept the intruder; one pair was led by Lt. (SG) Boris Dokin, with Lt. Tezyaev as his wingman, the other by Lt. (SG) Anatoliy Gherasimov, with Lt. Satayev as his wingman.

Spotting the American aircraft over the Baltic Sea off Liepaja, the fighter pilots first gave the required signals, ordering it to head for a landing, and fired warning shots when the Privateer ignored the commands. The American gunners opened fire on one of the

A typical production MiG-9 in overall grey finish.



The Yak-15, too, was used on a very small scale by the PVO. This example is in standard green camouflage.

Two views of the flight line of a fighter unit equipped with Yak-15s.

This Yak-15 wore a light grey air superiority colour scheme.

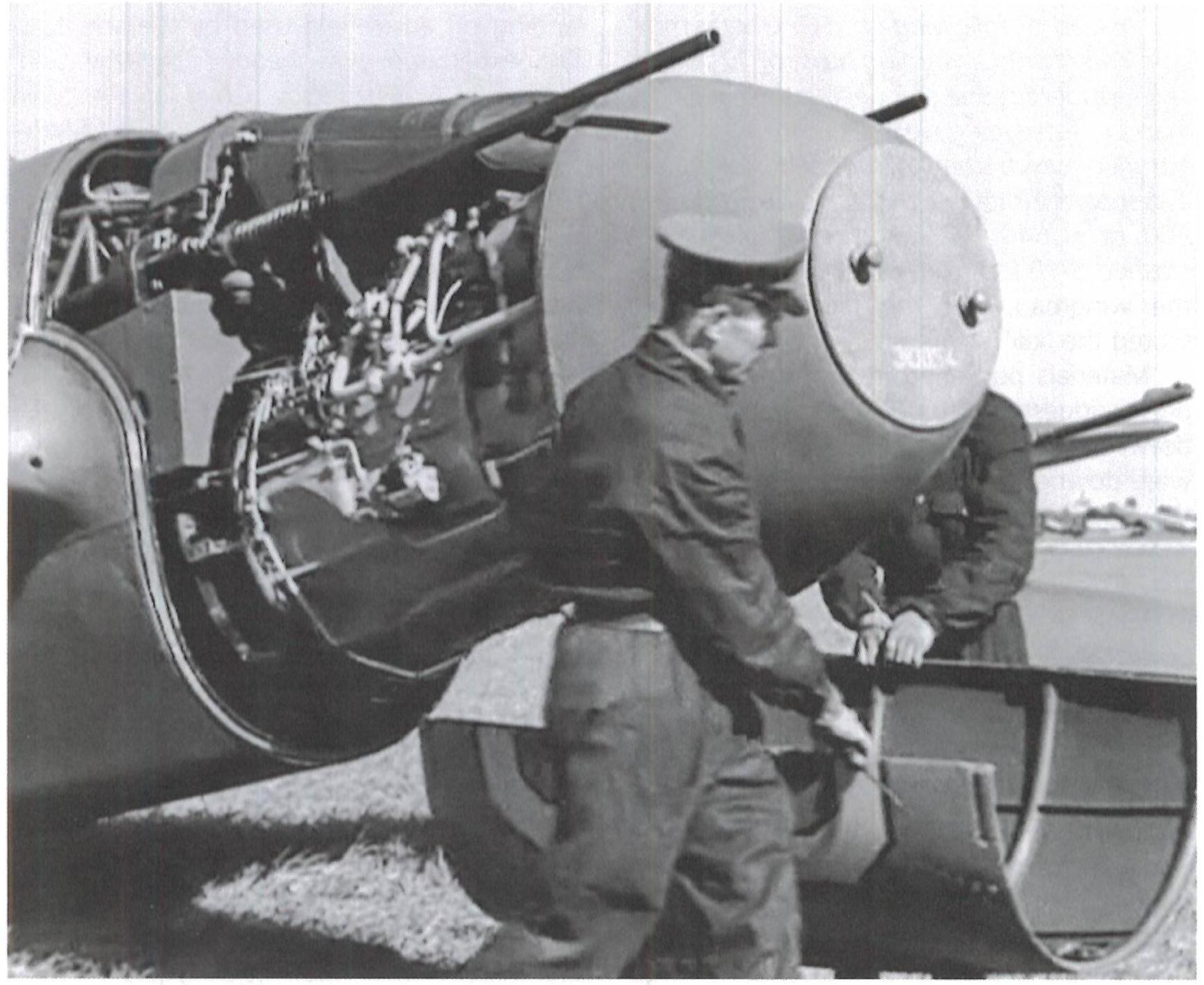
fighters, but the spyplane was hit by cannon fire immediately afterwards and plunged into the sea 5-10 km (3.1-6.2 miles) off the coast near Gotland Island. All ten crew members perished; they were Lt. John H. Fette, Lt. Howard W. Seeschaf (his last name was also reported as Skeschaf), Lt. (JG) Robert D. Reynolds, Ens. Tommy L. Burgess, AT1 Frank L. Beckman, AD1 Joe H. Danens Jr., AD1 Jack W. Thomas, AL3 Joseph Jay Bourassa, CT3 Edward J. Purcell and AT3 Joseph Norris Rinnier Jr. (Note: AT1 = Aviation Electronics Technician Petty Officer 1st Class; AT3 = ditto, 3rd Class; AD1 = Aviation Machinist's Mate Petty Officer 1st Class; AL3 = Aviation Electronicsman Petty Officer 3rd Class; CT3 = Communications Technician Petty Officer 3rd Class.) The wreckage of the Privateer was later recovered. This was the first case when the La-11 fired its guns in anger.

Interestingly, for a long time the Soviet side maintained that the aircraft involved in the 8th April 1950 shootdown was a Boeing RB-29, and some of the official documents relating to the incident give the type as such. This story was also voiced by the Russian daily newspaper *Izvestiya*, which later conducted an investigation of the incident. On reflection, this confusion is not surprising – the Superfortress and the Privateer have the same layout but the Privateer is much less known. However, the USA does not acknowledge the loss of a B-29 that day.

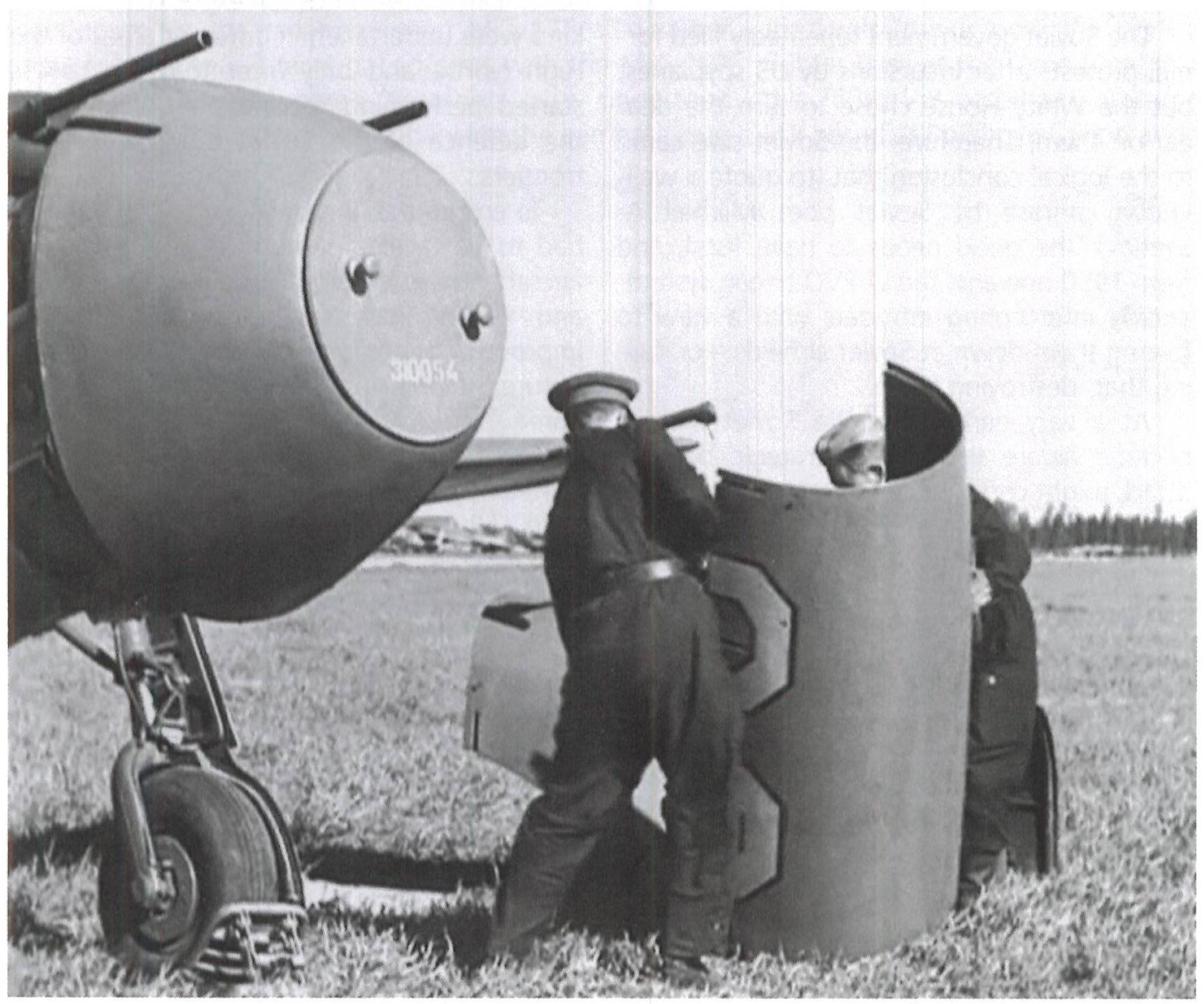
This is how Soviet documents of the day record this episode. The border incursions log contains the following entry: *'8.04. 1730 hrs* (Moscow time – *Auth.*) *– a border incursion south of Liepaja. An American B-29 aircraft proceeded 29 km [18 miles] into Soviet territory. It ignored our fighters' instructions to follow them and opened fire. When the lead fighter (sic) returned fire the aircraft headed seawards and disappeared (sic).'*

The report filed by Lt. (SG) Boris Dokin, the fighter flight leader, to his regiment CO gives a slightly different picture: *'While on hot alert in the quick reaction alert flight, I received orders to take off at 1722 hrs. After take-off I was instructed to climb to 4,000 m [13,120 ft] and assume a heading of 360°. [...] At 1730 hrs I encountered a four-engined aircraft wearing American insignia; it was 8 km [4.97 miles] south of Liepaja* (that is, directly above the coastline – *Auth.*)*, travelling on a heading of 135°. On sighting the aircraft I, together with my wingman, approached it in the starboard rear quadrant and gave orders to the other pair led by Lt. (SG) Gherasimov that the intruder should be forced down at our airfield. Gherasimov positioned his aircraft ahead of the intruder and rocked his wings, initiating a left turn* (the internationally recognised 'follow me' sign – *Auth.*)*. However, the intruder turned onto a heading of 270°, making for the*

The engine of a Yak-15 is warmed up with hot air from a lorry-mounted heater before a winter sortie.



A view of a Yak-15 with the engine cowling removed, exposing the RD-10 engine, its oil tank and the two NR-23 cannons.



Here, technicians remove the two halves of the Yak-15's cowling.

sea instead of following Lt. (SG) Gherasimov's pair. Then I fired a warning burst of 12 rounds. The intruder fired at me. Seeing this, my wingman Lt. Tezyayev gave a cannon blast at the intruder, which then descended steeply and disappeared into the clouds at an altitude of 500 m [1,640 ft]. The aircraft presumably crashed 5-10 km from the shore.' Thus it was the wingman, not the flight leader, who scored the 'kill'.

Materials published in the Soviet popular press suggest that the 8th April 1950 shootdown was *not* the first case when US aircraft were downed by Soviet fighters. Thus, one of the Soviet military pilots maintained that a similar clash occurred over the Black Sea near the Ukrainian seaport of Odessa in the autumn of 1949. A US Air Force B-25 intruding into Soviet airspace inserted a three-man special operations team by paradropping near Kirovograd, a regional centre in the Ukraine, but was intercepted on the way out and shot down by Soviet fighters before it could reach international waters. The crew bailed out and were picked up by a Soviet Border Guards fast patrol boat. Other incidents of this kind are known to have occurred in the late 1940s but the information on them stored in Russian military archives is still unavailable.

The Soviet government repeatedly filed formal protests after incursions by US spyplanes, but the White House chose to turn the deaf ear on them. Therefore, the Soviet side came to the logical conclusion that (to quote a well-known phrase by Soviet poet Mikhail A. Svetlov) 'the good needs to have fists', and from 1950 onwards the IA PVO began systematically intercepting intruders with a view to forcing them down at Soviet airfields – or, failing that, destroying them.

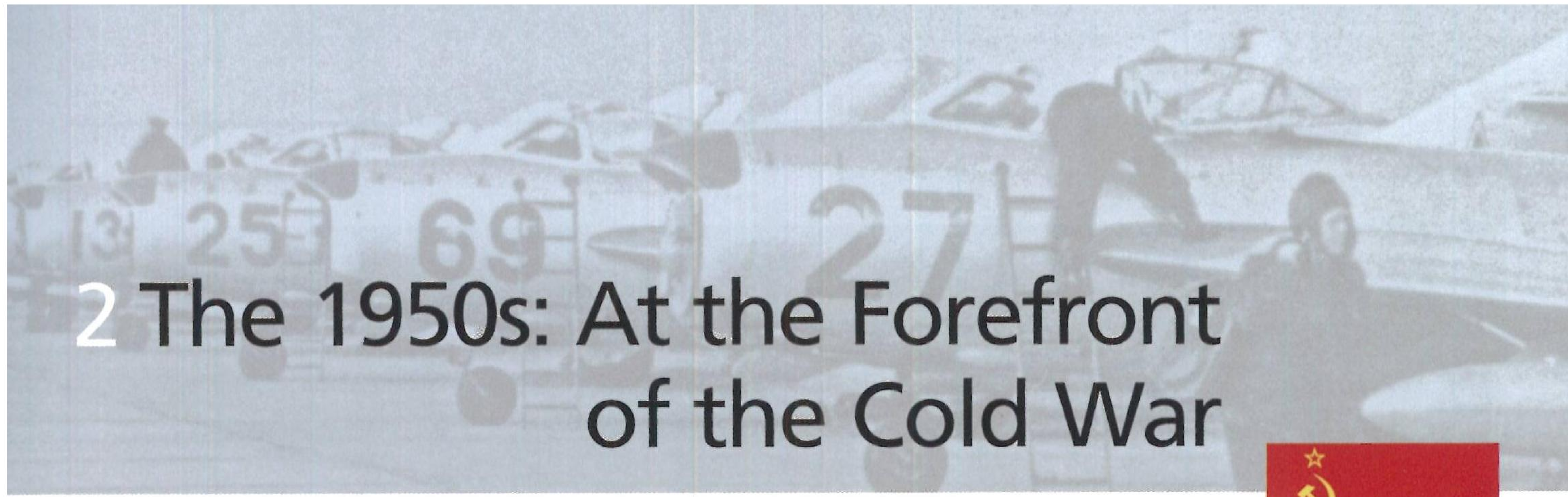
At a very early stage the Soviet military became aware that a US strategic bomber attack might come from across the North Pole. Therefore, when the La-11 fighter was still under development, someone suggested deploying the aircraft at airfields in areas to the north of the Arctic Circle and on drifting icefields for defending the Soviet Union's Arctic regions against unbidden guests. This called for a number of experiments associated with the deployment of the La-11s at ice-borne airstrips in the High North.

One such expedition took place in 1948. At that time several expeditions sponsored by the Soviet Academy of Sciences were working near the North Pole. A decision was taken to send a group of La-11s with the task of landing on an icefield used by the scientists. The expedition was headed by Maj.-Gen. Aleksandr A. Kuznetsov, Chief of the Main Directorate of the North Sea Route (GUSMP – ***Glahv**noye oopravl**en**iye **Sev**ernovo mor-**sko**vo pu**tee***). Catering for the expedition was ensured by crews of a Lisunov Li-2 *Cab* transport from the 650th Independent Airlift Regiment, a Douglas C-47 Dakota from the 1st Airlift Regiment of the 2nd Special Mission Air Division and an Il'yushin IL-12 *Coach* airliner from the 708th Special Mission Airlift Regiment. A twin-engined Tu-6 reconnaissance aircraft (a version of the Tu-2 *Bat* bomber) used as a pathfinder and three La-11s conducted training flights in Arctic conditions, with Cape Schmidt and Wrangel Island as their bases. At first the Tu-6 took off from the island of Wrangel for a reconnaissance flight, making use of its reasonably good navigation equipment. It landed successfully on an icefield near the North Pole. Then it returned to the mainland and, when a spell of good weather set in, on 7th May 1948 three La-11s led by the Tu-6 pathfinder set course towards the icefield where they made a safe landing. On 8th May, having performed several practice flights from the location, they returned to base. Later, several other expeditions of the kind were undertaken in different areas of the High North, and only after that the La-11s started performing routine patrol flights for the defence of the Soviet Union's northern frontiers.

To ensure this, a number of technical issues had to be tackled. Among other things, the aircraft had to be fitted with de-icing systems and the navigation equipment had to be improved. Importantly, it was necessary to ensure the possibility of taking off from unprepared snow-covered airstrips.

La-11s operated by the 1st IAD (*istre**bi**tel'naya **a**viadi**vee**ziya* – Fighter Division) and the 53rd IAP were involved in the work in the North Pole area at different times. In December 1949 some of the participants of the expedition were awarded the HSU title. Among those who received the award were squadron commander V. D. Borovkov and navigator S. A. Skorniakov (group commander) from the 1st IAD, as well as 53rd IAP Deputy CO V. A. Popov.

The idea of *ad hoc* airstrips built on icefields occupied the minds of the military for quite some time, but none of these airstrips was ever placed on a regular duty for the purpose of conducting combat patrol missions.



2 The 1950s: At the Forefront of the Cold War

In the 1950s the IA PVO units began re-equipping with second-generation swept-wing jet fighters. The first of these were the subsonic MiG-15 and MiG-17, followed by the supersonic MiG-19. The latter two types saw service with PVO units both in the basic day fighter version and in radar-equipped all-weather interceptor versions. Some of the specialised interceptors (the MiG-17PFU, MiG-19PT and MiG-19PM) were armed with air-to-air missiles in addition to (or instead of) cannons, allowing them to engage manned or unmanned aerial vehicles beyond visual range. The Air Defence Force also fielded the new Yak-25/Yak-25M twinjet interceptor optimised for low-altitude operations. As of 1st May 1953 the IA PVO fleet amounted to 2,958 assorted aircraft.

On 29th August 1951 the PVO Aviation's Red Banner Training & Methodical Centre at Savasleyka AB commenced service trials of a batch of 40 MiG-15*bis Fagot-B* fighters. In 1953 the Centre started developing new combat tactics for the radar-equipped MiG-17P all-weather interceptor; a year later it got to grips with the MiG-19P and Yak-25. The Centre's personnel also undertook research work aimed both at enhancing the combat capabilities of existing fighter types and at developing air combat tactics and intercept techniques tailored for the latest interceptors then under development or being fielded. In 1955 a total of 108 pilots and 95 ground crewmen completed their conversion training for the Yak-25M in Savasleika; the personnel numbers for the MiG-19P were 29 and 48 respectively. (This apparent disproportion between the aircrew-to-ground crew ratios is due to the fact that the Yak-25 was a two-seater.)

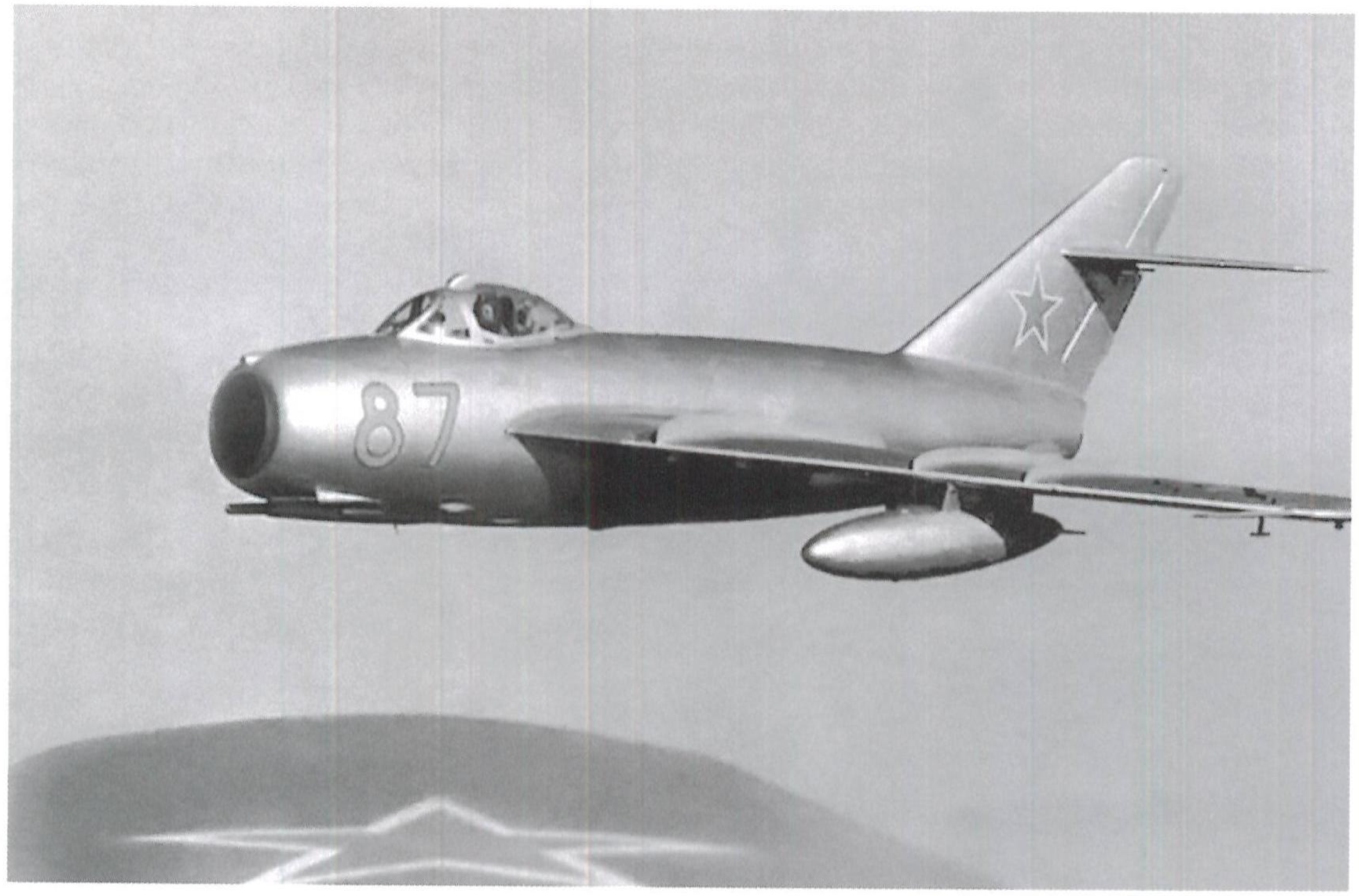
As early as the late 1940s the Soviet aircraft industry switched to mass production of jet-powered aircraft and indigenous turbojet engines for same. Accordingly, in the early 1950s the fighter regiments of the Soviet Air Force and the IA PVO were re-equipping *en masse* with jets. In so doing the existing wartime fighter units of the IA PVO were often disbanded and new ones established instead. Thus, for example, the PVO's 87th IAD was formed at Bol'shoye Savino airfield near Perm', a regional centre in the Urals (this is now the city's principal airport and a fighter base at the same time) in July 1952. It comprised the 763rd IAP based at Komsomol'skiy-2 AB, the 764th IAP based at Bol'shoye Savino and the 765th IAP based at

A pair of blue-coded MiG-17s *sans suffixe* over a mountainous area. In defiance of superstition the wingman's aircraft is coded '13 Blue'.

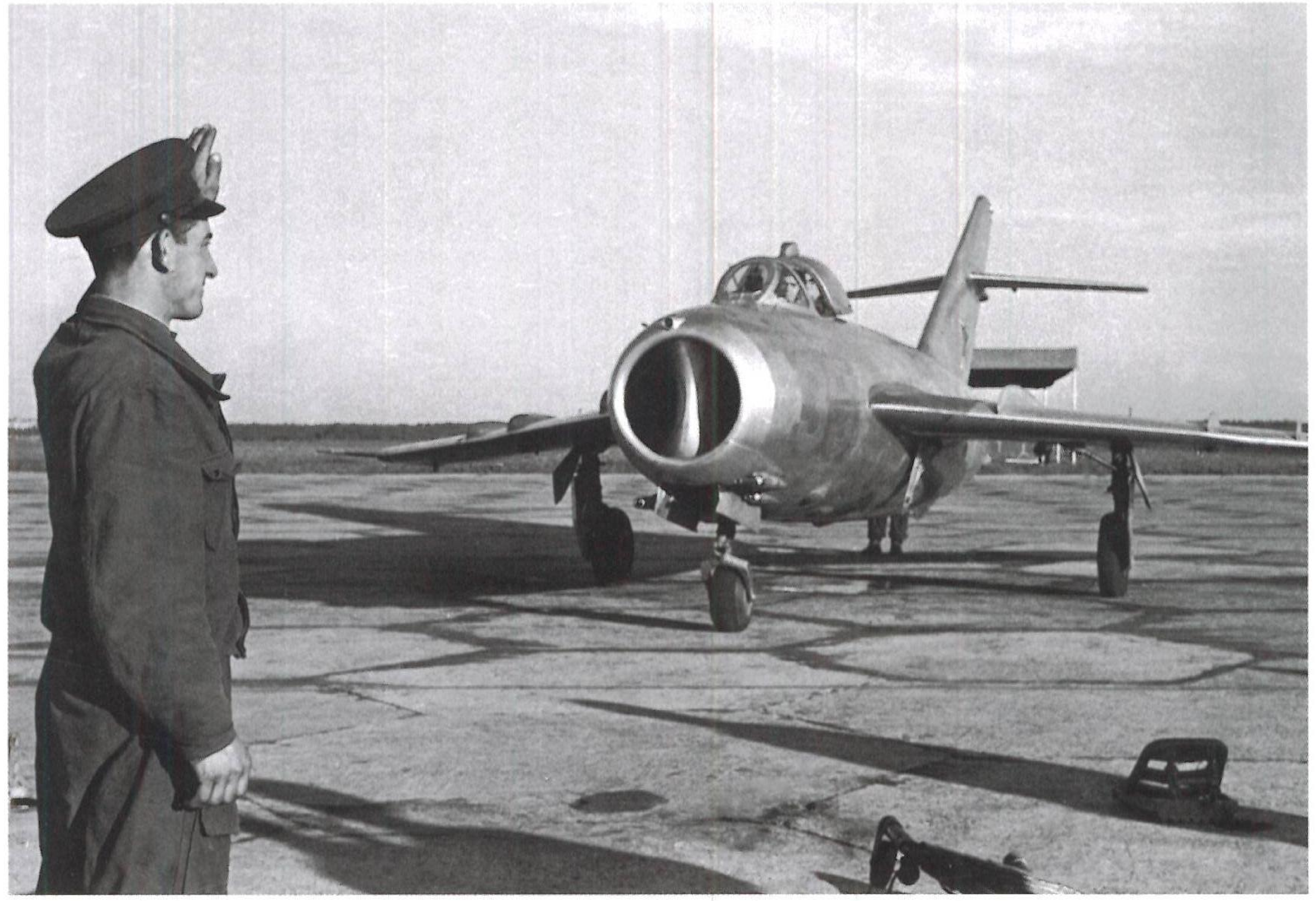
Nizhniy Tagil. The division was commanded by Col. Nikolay Yelagin and operated MiG-15 fighters; the first combat jet stationed in the Urals took to the air on 8th April 1953.

Here it should be noted that in the post-war years the IA PVO's order of battle changed more than once. The air armies, corps, divisions and regiments were repeatedly reorganised, changing their numbers, structure and subordination. In so doing the unit numbers were allocated without any logic; while this was probably unintentional, it aided security by confusing the picture for the casual observer (read: spy).

Previous page: Four MiG-17s on quick-reaction alert (QRA) duty, with a line of sister ships in the background.



A MiG-17 *sans suffixe* seen from another fighter. Note the rear view mirror on the canopy and the 400-litre drop tanks.



In this publicity shot, a ground crewman waves to greet the pilot of MiG-17 '39' while his colleague checks the fighter's rear end.

In 1948 Col.-Gen. Yevgeniy Ya. Savitskiy (Twice HSU) was appointed Commander of the IA PVO; however, he was soon removed from office in the political turmoil and scramble for power that followed the death of the Soviet leader Iosif V. Stalin on 5th March 1953. Lt.-Gen. Mikhail G. Machin became the new IA PVO Commander; yet he, too, did not last long, being demoted to Commander of the fighter aviation in the Urals Independent PVO

MiG-17 pilots clad in leather jackets walk down the flight line. Note that the second aircraft in the row has unusual air-brakes located well forward.

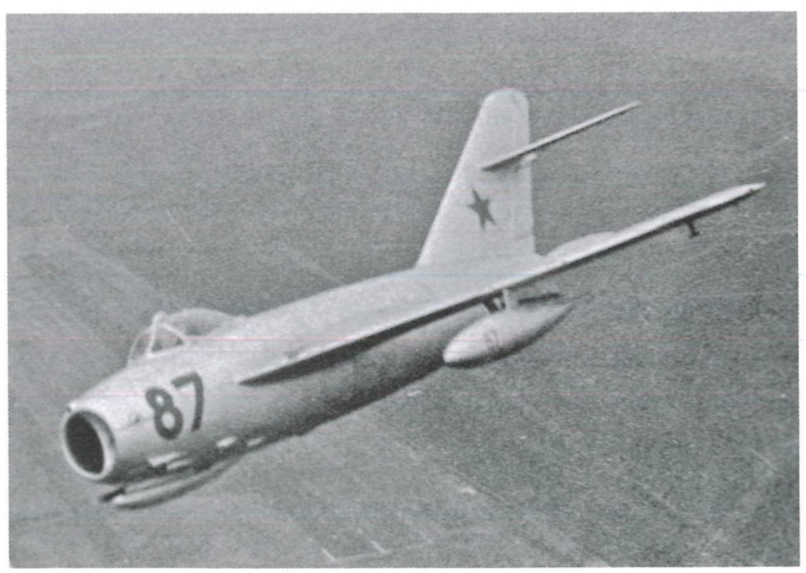
A late-production MiG-17 *sans suffixe* takes off, showing the airbrake actuator fairings ahead of the engine nozzle.

Opposite page, above: A pair of MiG-17s *sans suffixe* break formation with the camera ship.

Opposite page, below: This *Fresco-A* is seen from a NATO aircraft during a real-life intercept.

Army. However, it was under Savitskiy's guidance that the Soviet Air Defence Force's fighter element began putting up resolute and effective resistance to reconnaissance flights along the borders and incursions into Soviet airspace, as Savitskiy – known by his wartime radio callsign *Dra**kon*** (Dragon) – had immense combat experience and enjoyed great authority among the flying personnel.

Given the huge length of the nation's frontiers, it was impossible to post IA PVO units everywhere in the borderside regions. Therefore, air defence tasks were also performed by fighter units controlled by the Air Force and the Naval Aviation (AVMF – *Avia**h**tsiya Voy**e**nno-mor**sk**ovo **flo**ta*) stationed around the perimeter of the country.



MiG-17 *sans suffixe* '87 Red' in flight near Tikhoretsk. Note the 'Excellent aircraft' maintenance award badge on the extreme nose.

After the loss of the US Navy Privateer over the Baltic Sea on 8th April 1950 (see previous chapter) the Americans became more cautious, preferring not to tangle with the Soviet air defence system. On 5th May 1950 the US Joint Chiefs of Staff (JCS) formulated the aims and methods of aerial reconnaissance operations against the Eastern Bloc. The main emphasis was placed on SIGINT, which was meant to reveal the number and placement of the Soviet AD radars and determine their capability against aerial targets. General of the Army Omar Nelson Bradley, who was then Chairman of the JCS, proposed calling these operations *'an airborne electronic intelligence project'* and tasked the reconnaissance branch of the USAF with obtaining *'all possible information on the adversary's electronic assets'*. The guidelines for such operations were defined as follows:

1. Maintain a stand-off distance of at least 20 miles from the border of the Soviet Union or Soviet-controlled states;
2. Do not deviate from the assigned route;
3. Generally, reconnaissance aircraft shall be unarmed.

Thus began the flights of American 'ferret aircraft' along the borders of the Soviet Bloc that went on for decades. Such missions were fraught with considerable danger for all parties involved, often leading to incidents and skirmishes between the spyplanes and the Soviet fighters – and it was not necessarily the latter that emerged victorious from the battle.

In May 1950 an engagement between

Soviet and US Air Force fighters took place over the Chukotka Peninsula. La-11 pilot V. S. Yefremov claimed to have shot down a North American F-51D Mustang.

On 14th July 1950 a US Air Force RB-29 intruded into Soviet airspace and was fired upon near Permskoye airfield, but escaped unscathed.

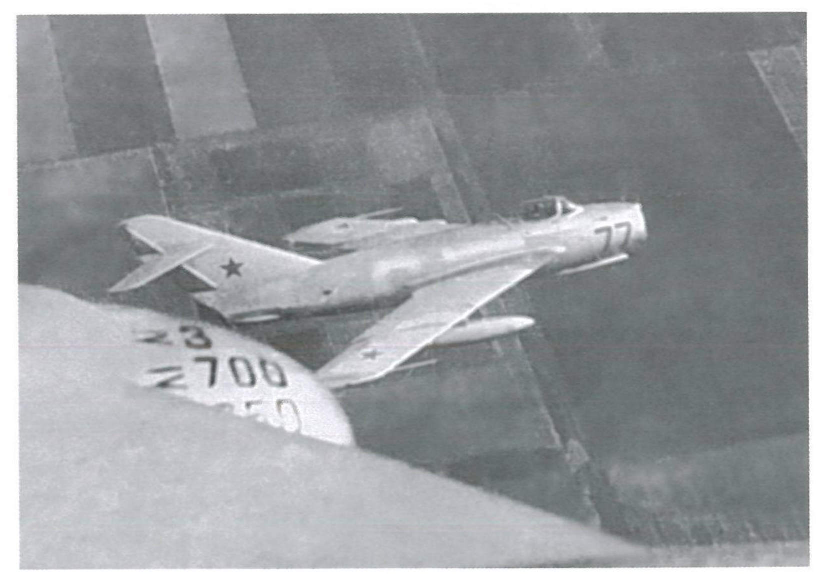
Sometime between October and December 1950 a US Navy Lockheed P2V Neptune maritime patrol aircraft of VP-6 piloted by Arthur Farwell was intercepted at night by four MiG-15s near Vladivostok in the Soviet Far East. The Neptune's tail gunner opened fire, shooting down one of the fighters. This was probably the first Soviet casualty in this 'secret war'.

On 26th December 1950 another RB-29 was detected by Soviet air defences over the Tyumen'-Oola River in the Far East. This time the Superfortress was less lucky. Two 523rd IAP MiG-15s flown by Capt. Stepan A. Bakhayev and Lt. (SG) N. Kotov scrambled to intercept, attempting to force the intruder down at their home base, but were fired upon by the RB-29's gunners and returned fire, destroying the aircraft.

On 11th May 1952, a pair of Soviet MiG-15s intercepted a US Navy Martin PBM-5 Mariner flying boat over the Sea of Japan, making six attacks but inflicting only minor damage. One source claims the aircraft was a Martin P5M Marlin amphibian.

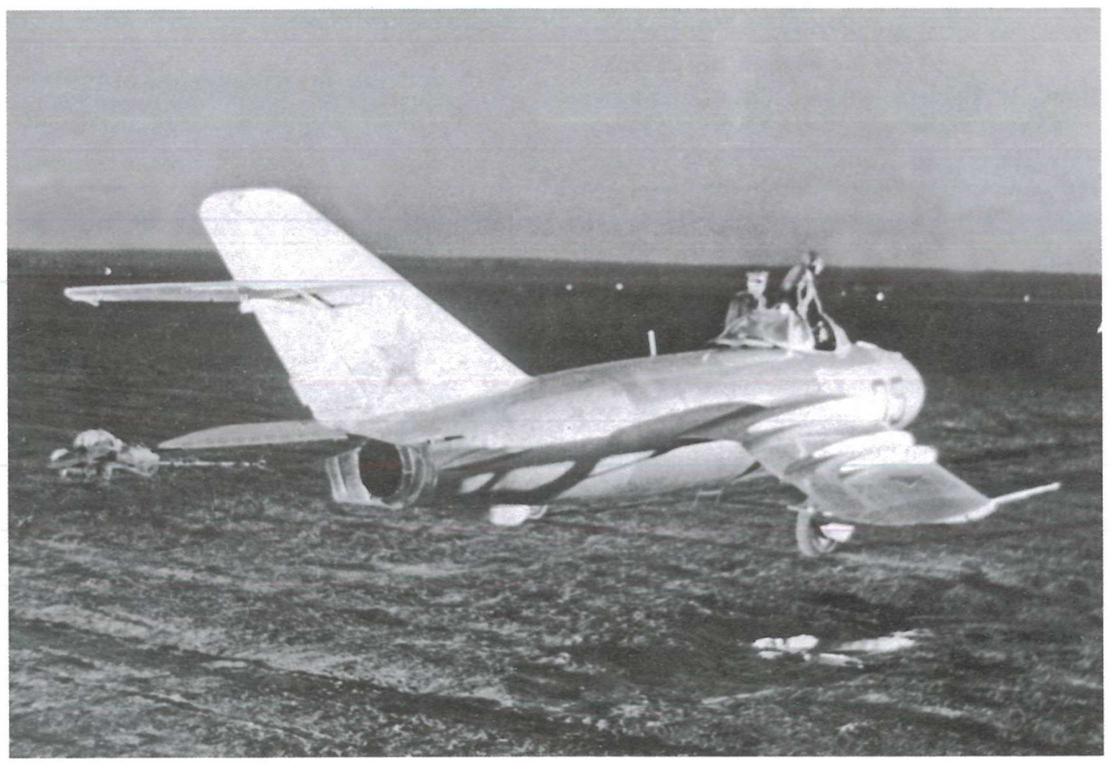
In 1952 the USAF lost two RB-29 reconnaissance aircraft with all hands. One of them was RB-29A-50-BN (44-61810, c/n 11287) of the 91st Strategic Reconnaissance Squadron 'Demon Chasers', which took off from Yokota airbase in Japan on 13th June 1952, flying a classified surveillance mission of shipping activity in the Sea of Japan. At 1320 hours local time (other sources say 1007 hrs Japanese time) radar contact with the aircraft was lost when, according to the crew, the RB-29 was over the Sea of Japan near the Soviet coast. A search and rescue effort turned up nothing more than empty life rafts. The crew of 12 (Sam Busch, Robert J. McDonnell, Roscoe G. Becker, Eddie R. Berg, Leon F. Bonura, William R. Homer, Samuel D. Service, James A. Sculley, William A. Blizzard, Miguel W. Monserrat, Danny Pillsbury and David L. Moore) were all listed as missing; their bodies were never found.

The US Embassy in Moscow sent an official note of enquiry to the Soviet government regarding the fate of the missing aircraft but



MiG-17F fighters are serviced on the flight line. The vehicle in the foreground is an APA-12 ground power unit based on the GAZ-69 jeep.

A pair of MiG-17Fs carrying 400-litre drop tanks take off.

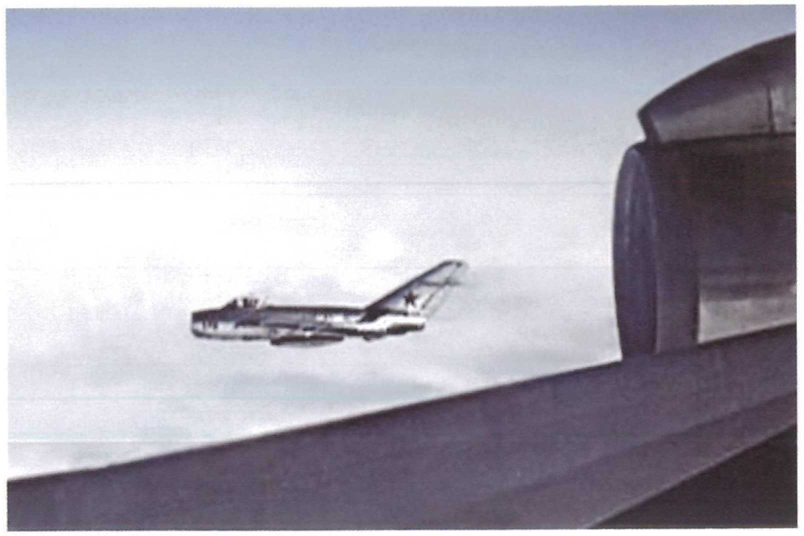


A MiG-17F pilot climbs into his aircraft for a sortie at dusk.

Opposite page: MiG-17Fs on a snow-covered ramp. An APA-7 GPU based on the Moskvich-400/420K pick-up (number plate U1-56-54) powers up the nearest aircraft.

got no answer. The US government chose not to pursue the issue further. The State Department informed the Japanese government that no special investigation of the case had been held, while the crewmembers' families were simply told that the aircraft had gone missing in action. Later it came to light that the RB-29 had been intercepted by two MiG-15s piloted by Capt. Oleg P. Fedotov and Lt. (SG) Ivan P. Proskoorin, who established visual contact with the Superfortress in the area of Valentin Bay, 14.5 km (9 miles) from the Soviet coast and 180 km (111.8 miles) from Vladivostok. According to the pilots'

MiG-17F pilots receive a last-minute briefing in front of their mounts. Note the large airbrakes of the MiG-17F.



A MiG-17F flies off the starboard wing of a Boeing RC-135 in 1972.

reports, the RB-29 fired on the Soviet fighters; the latter returned fire and the spyplane burst into flames, diving into the Sea of Japan within Soviet territorial waters.

Until the early 1950s the PARPRO operations were limited to the peripheral regions of the USSR. However, once US President Harry S. Truman had endorsed a plan envisaging aerial reconnaissance over the Soviet Union's inner regions, incursions by US aircraft (and not necessarily spyplanes) deep into Soviet airspace became increasingly common. Occasionally their routes took them across several of the country's regions. Such missions were flown in co-operation with the USA's NATO allies, and this means not only using bases in Europe but also the participation of foreign personnel. Thus, RB-47s operated from RAF Fairford in Gloucestershire, and the older North American RB-45C Tornados were based at RAF Sculthorpe in Norfolk. The RAF set up a secret outfit called 'Special Duty Flight' with four Tornados, which were painted in Royal Air Force markings for appearance's sake. The agreement to conduct a joint aerial reconnaissance program to overfly the European USSR had been reached in late 1950 by Truman and the then British Prime Minister Clement R. Attlee, but the actual overflights were approved by the new PM, Winston Churchill, who was re-elected in October 1951.

Thus, on the night of 17th/18th April 1952 three quasi-RAF RB-45Cs flown by US and British crews departed Sculthorpe, maintaining complete radio silence. The mission was code-named Operation *Ju-Jitsu*. Breaching the Soviet border, they fanned out to follow three routes across the Baltic republics in the north, Belorussia in the centre and the Ukraine in the south; the machine flying the southern route was flown by an RAF crew – pilot Sqn Ldr John Crampton and navigator Flt Lt Rex Sanders. As the RB-45s cruised leisurely at about 12,000 m (36,090 ft), the scrambling Soviet fighters were unable to reach the intruders, which proceeded as far east as Pskov (north-western Russia), Smolensk (western Russia) and Khar'kov (eastern Ukraine) respectively. All three aircraft photographed strategic bomber bases, as well as the nearby IA PVO bases.

Between 2nd April and 16th June 1952 a US Air Force RB-50 flew eight or nine daytime missions from NAS Kodiak or Shemya AFB in

Another MiG-17F gets really close to an RC-135 in 1971. This practice aimed at forcing the spyplane to leave the area (or land, if an incursion has taken place) is known in USAF slang as 'thumping'.

Routine maintenance of a MiG-17PF all-weather interceptor.

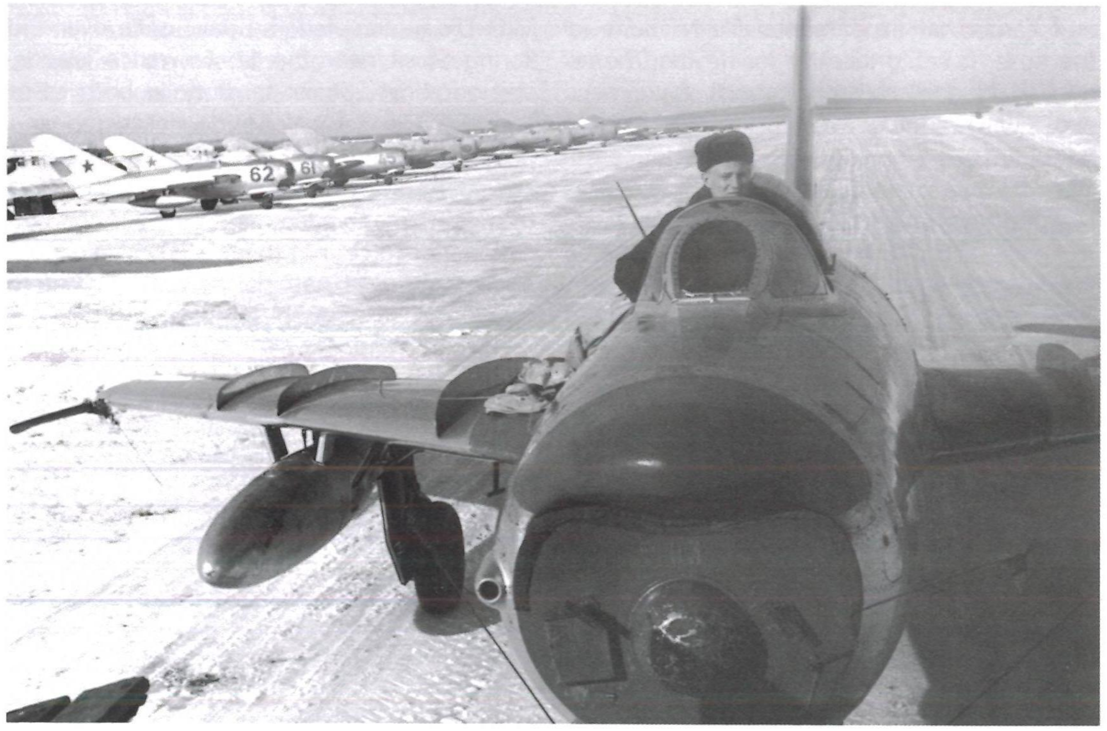
the Aleutian Islands, working together with a specially modified US Navy Lockheed P2V-3W that carried an experimental SIGINT suite in the nose; it could identify, locate, and home on radars and communications equipment over a wide range of frequencies. Flying inland 24-32 km (15-20 miles) from the Soviet coastline, the pair maintained strict radio silence, even on take-off and landing. They managed to locate and photograph Soviet installations from the Kamchatka Peninsula in the south to Wrangel Island in the north. The P2V-3W flew at 4,570 m (15,000 ft), pinpointing targets for the RB-50 tagging along above and behind it.

On two of these overflight missions, Soviet MiG-15s intercepted the pair: once over the Bering Strait near the St. Lawrence Islands, and once over Soviet territory. In both cases the MiG-15s flew alongside, inspected and photographed the US planes, but did not attack. At the time, there was apparently a tacit gentleman's agreement between the two nations' air forces not to initiate hostile action.

As the Soviet national air defence system developed, the deep penetration missions became increasingly risky. Two intruders each

Another MiG-17PF being serviced, with engine access panels removed. The twin radomes of the RP-1 radar are clearly visible.

A dozen MiG-17PF interceptors ready for action. A TZ-150M refuelling bowser on a ZiS-150 chassis is visible at the end of the flight line.



A technician takes a ride in the cockpit of a 28th GvIAP MiG-17PF being towed at Andreapol'. The other aircraft are MiG-17 *sans suffixe* day fighters.

were shot down by Soviet air defences in 1950, 1951 and 1952, and three in 1953.

On 15th July 1952 a USAF Martin RB-26 Marauder weather reconnaissance aircraft was attacked over the Yellow Sea. Sixteen days later, Pacific Fleet MiG-15s attacked another PBM-5 near the same spot.

On 7th August 1952 two MiG-15s piloted by Lt. (SG) Zeryakov and Lt. (SG) Lesnov shot down a USAF RB-29 over the Kurile Islands. The crew of nine died; the remains of one crewmember, Capt. John R. Durnham, were returned to the United States in 1993.

On 18th November 1952 a fierce fight broke out near Cape Gamov, also in the vicinity of Vladivostok, between four Pacific Fleet/781st IAP MiG-15*bis* fighters and three US Navy/VF-718 Grumman F9F-2 Panthers operating from the aircraft carrier USS *Princeton* (CV-37) which was then 100 km (62 miles) from the

Soviet coast. In this case the Soviet Navy fighters were flying a mission to defend the nation's borders, as a PVO unit. Capt. Dmitriy Belyakov managed to inflict serious damage to Lt. (JG) David M. Rowlands' aircraft, but seconds later he and Lt. (SG) Vandalov were shot down by Lt. Elmer Royce Williams and Lt. John Davidson Middleton; their bodies were never found. The pilot of a third MiG-15*bis*, Pakhomkin, was mortally wounded but managed to make an emergency landing on the shore.

The 781st IAP CO's report on the incident reads:

'At 1417 hrs a group of unidentified aircraft was detected south of Cape Gamov. At 1438 hrs the group headed north, approaching our territory.

At 1448 hrs flight leader Capt. Belyakov reported on the radio that two aircraft were trying to get on his tail and that he was engaging them. After that, radio contact with the fighters was lost.

It has been established that the dogfight took place at 6,000 m [19,685 ft] over the sea, 30-35 km [18.6-21.75 miles] off Cape Gamov and 10-15 km [6.2-9.3 miles] from our maritime border.

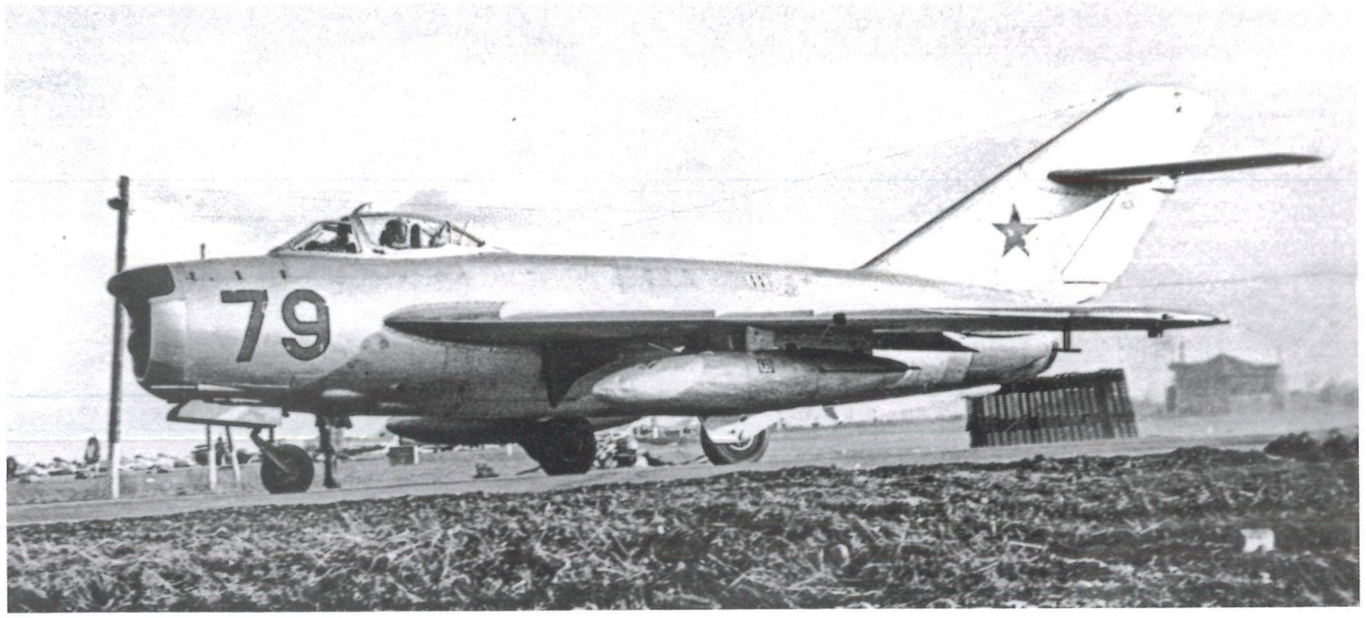
Of the four fighters [in the flight], only one, which had become separated from the others, returned to base. One more fell into the sea near Cape Lev due to engine failure, killing the pilot, and did not participate in the engagement. The other two were presumably shot down by the Americans.'

A MiG-17PF is decontaminated during a nuclear/biological/chemical (NBC) warfare exercise.

The latter part of the report was later confirmed by the US. On the other hand, the US acknowledges the loss of a single aircraft that day.

As mentioned earlier, the US aerial reconnaissance units' top priority target was the Soviet network of AD radars. In the Far East, American SIGINT aircraft operated from bases in Alaska (Eielson AFB and Elmendorf AFB) and in Japan (Johnson AB and Yokota AB), prowling around the cities of Vladivostok, Khabarovsk, Sovetskaya Gavan' (the name means Soviet Harbour) and Sakhalin Island. The Far East was of special interest because here the Soviet Union and the USA were closest geographically; hence the Pentagon wanted to find out more about the Soviet air-

A MiG-17PF pilot walks to his aircraft past a row of sister ships. Note the one coded '13' (again!).



A MiG-17PF taxies out for take-off. Drop tanks were always carried.

Three-quarters rear view of a taxying MiG-17PF, showing the after-burner nozzle and the large air-brakes.

fields on the Chukotka and Kamchatka peninsulas, which Tu-4 strategic bombers and Il'yushin IL-28 *Beagle* twinjet tactical bombers might use to strike at targets in the USA. (Of course, the airfields which were suitable for such missions – and hence were of interest for the Pentagon – were not limited to the Far East. For instance, the Soviet Air Force's strategic bomber component (DA – ***Dahl'****nyaya avi-* ***ah****tsiya*, Long-Range Aviation) was using Dikson on the Kara Sea as a Tu-4 staging area.)

In the early 1950s the US Air Force's Strategic Air Command (SAC) fielded a reconnaissance version of the six-turbojet Boeing B-47 Stratojet bomber – the RB-47. This was a highly capable reconnaissance platform that could reach a speed of 950 km/h (559 mph) and cruise at altitudes in excess of 10,000 m (32,810 ft); at high altitude the radius of its optical and radar field of view was close to 250 km (155 miles)! The unique long-range operations (LOROP) aerial cameras developed by US companies in 1953 made it possible to obtain detailed images from a range of 100 km (62.1 miles) or more.

The B-47 was virtually immune against fighter attack when it entered service, being beyond the capabilities of the MiG-15*bis* and MiG-17F fighters that made up the backbone of the Soviet Air Defence Force's fighter fleet at the time. Basically, all the Stratojet had to do in order to avoid being shot down was stay at least 150 km (93 miles) away from IA PVO fighter bases. In that case the Soviet subsonic fighters would use up all their fuel supply while catching up with the intruder (that is,

presuming they succeeded, given the Stratojet's high speed) and would be unable to reach their home base after the attack – and, given the scarcity of airfields in the northern regions of the Soviet Union, this almost inevitably meant a crash-landing. Besides, the B-47 was quite agile, and a seasoned pilot could foil the fighters' attempts to attack him simply by manoeuvring. Being short on speed, the MiG-15 would be unable to latch onto the tail of a Stratojet making evasive manoeuvres. Hence in most cases the Soviet interceptors did not scramble at all to try and stop an intruding RB-47, as it would be futile.

In 1952 the Stratojets started flying reconnaissance missions over Siberia at around 13,000 m (42,650 ft), mostly photographing Soviet airbases. At this altitude they were 'ungettable' for Soviet interceptors which were handicapped by an insufficient service ceiling. The first such mission took place on 15th October 1952. The aircraft in question were not even RB-47s yet – they were two B-47Bs from the 306th Bomb Wing at MacDill AFB, Florida, that had been specially modified for the mission. The mission was planned and executed in utmost secrecy; only the Commander of SAC, Gen. Curtis E. LeMay, and his directors of operations and intelligence knew the details. In the field, initially only Maj.-Gen. Frank Armstrong, CO of the 6th Air Division at MacDill (who was responsible for the project) and the 306th BW's deputy CO Col. Donald E. Hillman knew of it.

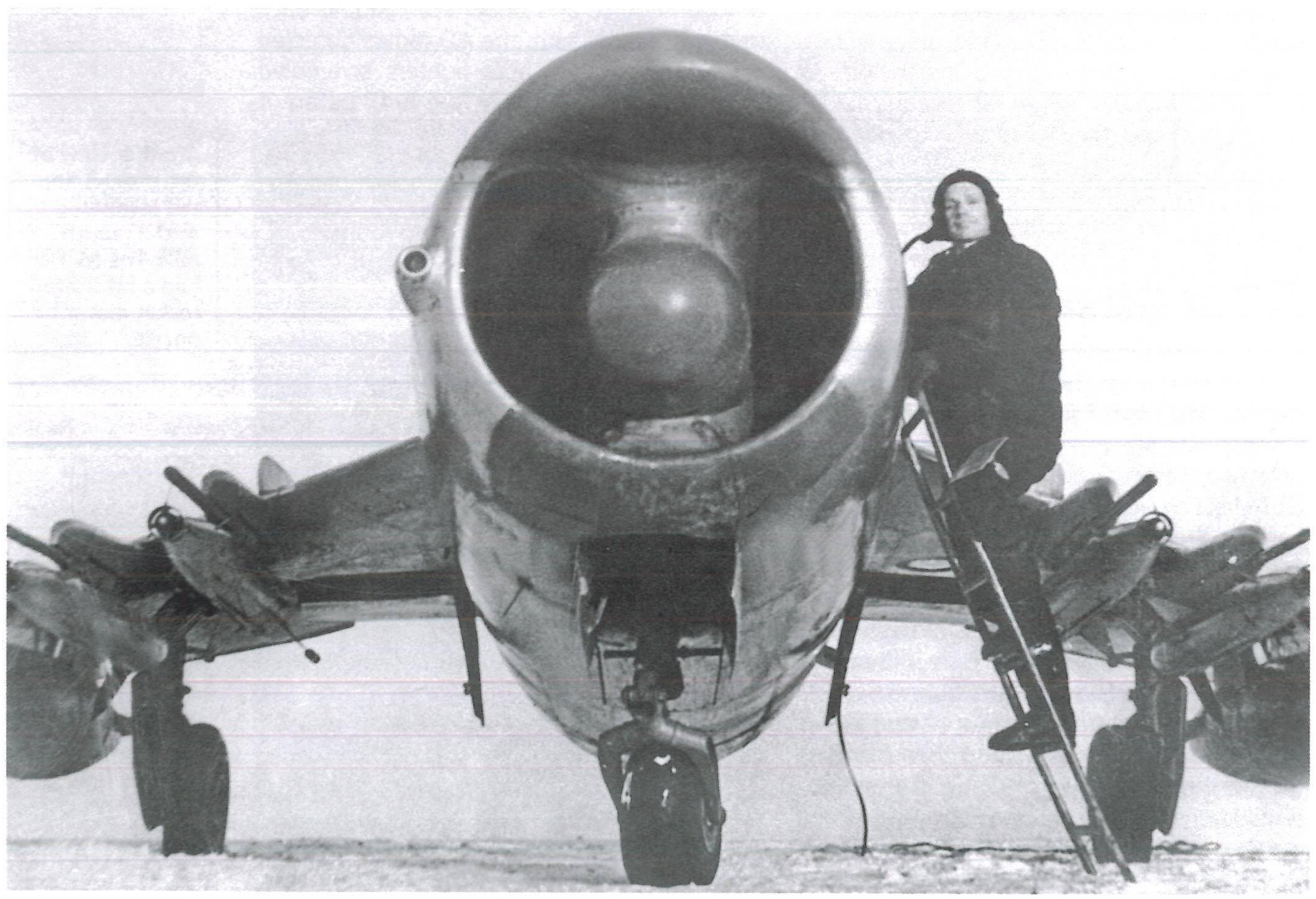
On 28th September the Stratojets, supported by two Boeing KC-97 tankers, redeployed from MacDill AFB to their FOL at Eielson AFB. After waiting two weeks for a favourable weather forecast in the target area, the Stratojets headed for the Soviet coast, topping up their tanks en route from the KC-97s near Point Barrow, Alaska. The primary aircraft was captained by Hillman, with Maj. Lester E. Gunter as co-pilot/gunner and Maj. Edward A. Timmins as navigator; the backup aircraft was manned by captain Col. Patrick D. Fleming, co-pilot/gunner Maj. Lloyd F. Fields and navigator Maj. William J. Reilly. The two B-47s entered Soviet airspace near Wrangel Island in the Arctic Ocean (between the East Siberian Sea and the Chukchi Sea). At this point they parted; Fleming's aircraft photographed Wrangel Island and then followed the northern coastline of Chukotka and loitered over the Chukchi Sea, obviously drawing the attention of the local PVO assets away from the other aircraft. Meanwhile, Hillman

A technician inspects the RS-1-US air-to-air missiles under the port wing of a MiG-17PFU interceptor.

continued on course past Wrangel Island, then turned southwest, crossing the Chukotka Peninsula. Over Provideniya (Providence) Bay in the Bering Sea the aircraft changed course and departed, heading back to Alaska. To be sure, the AD radars detected the intruder; MiG-15*bis* fighters scrambled but were unable to reach the B-47 before it

Another view of the missiles and the associated APU-3 launch rails. The RS-1-U had a bifurcated rocket motor nozzle.

Typical Soviet-era publicity shots of guardians of the Motherland's skies – in these cases, MiG-17PFU '05 Blue' with a full complement of AAMs and drop tanks. Note the tracers at the tips of the missiles' fins and the ring-shaped ram-air turbines supplying electric power, as well as the distinctive shape of the RP-1-U fire control radar's twin radomes.

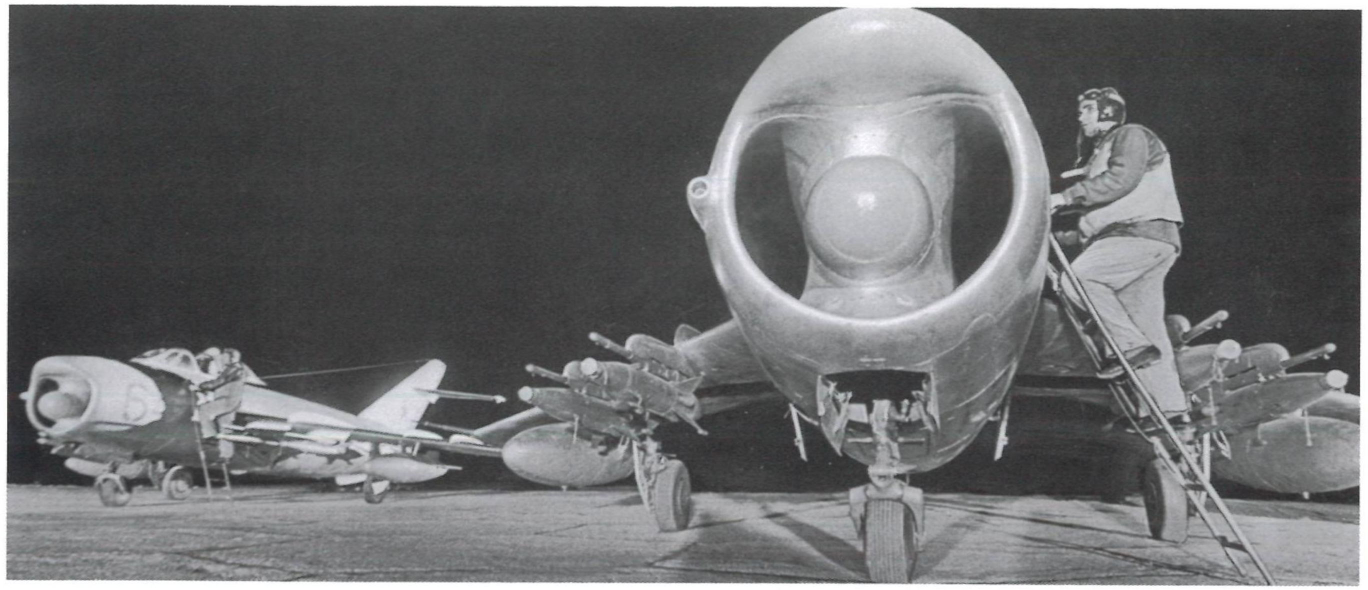


The forward fuselage of the same MiG-17PFU. Note the protective caps closing the ram-air turbine intakes on the missiles' noses; these caps are whisked away by special cables when the missile leaves the launch rail.

escaped, exiting Soviet airspace at the coast of the Chukotka Peninsula and cutting a 1,300-km (810-mile) track across Soviet territory. The pictures taken by Hillman's aircraft showed that the fears of Tu-4 bombers being massed in Siberia were unfounded. For this mission the crews of both B-47s received the Distinguished Flying Cross. After this incident the commander of the Far Eastern PVO District was removed from office, and the air defences in the area were bolstered by a further MiG regiment shortly afterwards.

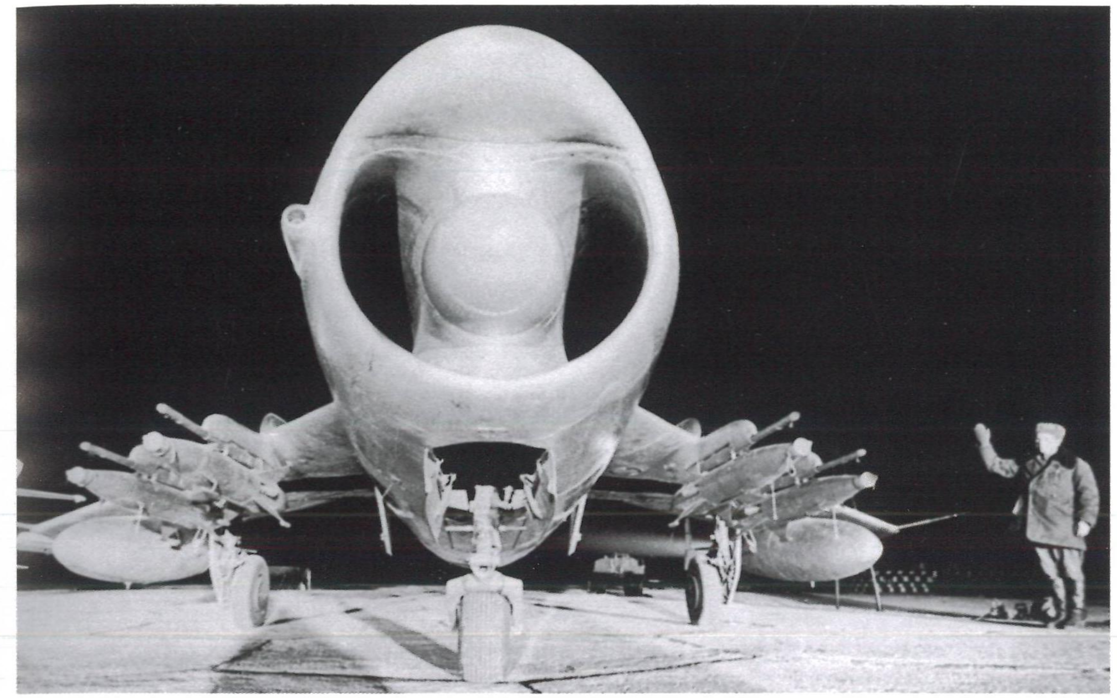
The piston-engined RB-29 and RB-50 aircraft continued in service, as their lower speed and service ceiling were offset by longer range. Hence the Superfortresses scouted the Soviet Union's northern coastline, which was a much safer route for them. Whilst the US reconnaissance aircraft operating in the Far East (which was thick with military bases and AD radars) were constantly bounced by Soviet interceptors, it was a different story in the High North. The crews of 'ferret aircraft' operating along the northern frontier soon discovered that radar pickets were few and far between in that region. This naturally led the US Air Force command, and the Pentagon at large, to assume that in a Third World War scenario the northern (cross-Polar) route would

In another typical Cold War-era publicity shot, the commander of a fighter unit briefs his pilots in front of a fully armed MiG-17PFU. Note the life jackets suggesting the interceptors operated over the sea.



The pilots of two MiG-17PFUs climb into the cockpits – supposedly to maintain QRA duty; yet the absence of attending technicians shows this to be another publicity shot.

Two more views of the same MiG-17PFU '05 Blue' – supposedly before a night sortie.



A ground crewman gives the 'all clear' signal as a *Fresco-E* prepares to taxi out.

be the best avenue of approach for SAC bombers attacking targets on Soviet territory.

The intensity of USAF reconnaissance operations mounted year after year. By the mid-1950s more than 100 photo reconnaissance (PHOTINT) and SIGINT aircraft were assigned to the task, and their coverage expanded gradually. The 55th Strategic Reconnaissance Wing based at Forbes AFB (Topeka, Kansas) had 30 to 40 aircraft; in West Germany, Wiesbaden was home to the 7499th Support Wing, while Yokota AB in Japan hosted the 91st SRS, both with 20 to 30 aircraft. Incursions into Soviet airspace, and intercepts (with varying success), continued. Soviet fighters would try to compel the intruders to land at their bases, and as the intruders would not comply, exchanges of fire ensued, often resulting in the loss of aircraft and crews.

On 15th March 1953 a USAF Boeing WB-50 Superfortress (officially a weather reconnaissance aircraft) of the 55th Strategic Reconnaissance Wing/38th SRS was intercepted by a pair of MiG-15s approximately 40 km (25 miles) off the Kamchatka Peninsula, near Petropavlovsk-Kamchatskiy. Though home-based at Forbes AFB, the WB-50 was on temporary deployment to Eielson AFB, Alaska, while assigned to the 15th Weather Reconnaissance Squadron. There was a short exchange of fire but the WB-50 got away and the MiGs returned to their base.

A month later, on 15th April 1953, a pair of Pacific Fleet MiG-15s intercepted a USAF RB-50 near the same spot. The intruder refused to obey orders to land and opened fire first. The result is predictable – the RB-50 was shot down near the village of Zhoopanovo and the crew went missing in action.

Exactly a month later (again!) there was an exchange of fire between a MiG-15 and a WB-29 snooping around the Kamchatka Peninsula. The Superfortress escaped, with no casualties on either side. It's uncanny how the USAF seemed to choose the 15th day of the month for such missions…

On 29th July 1953 a 91st SRS RB-50G with a crew of 17 (11 flight crew members and six reconnaissance equipment operators) took off from Yokota AB and skirted the Korean Peninsula before proceeding further north along the Soviet border. Soviet radars detected and tracked the intruder off Vladivostok, and a pair of MiG-15*bis* fighters led by Lt. (SG) Aleksandr D. Rybakov intercepted the spyplane near Gamov Bight in the Sea of Japan, instructing it to follow them and land at their home base. The RB-50's gunners opened fire, damaging the lead aircraft. Rybakov and his wingman Lt. (SG) Yuriy M. Yablonskiy then returned fire, shooting down the RB-50. Only one crewmember (co-pilot John E. Roche) survived.

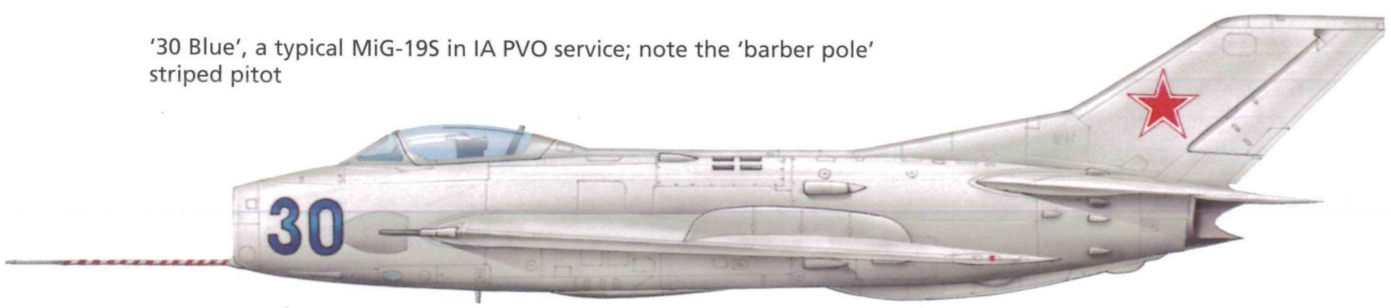
In his report to Minister of Defence Marshal Gheorgiy K. Zhookov concerning the incident, Soviet Navy Commander-in-Chief Fleet Admiral Nikolay G. Kuznetsov wrote: *'The [Pacific] Fleet radars continued tracking the unidentified aircraft and at 0701 hrs detected that it had entered our territorial waters – the*

A MiG-19S pictured in the late 1950s. The ORO-57K pods with S-5 unguided rockets were to be used against bombers as well.

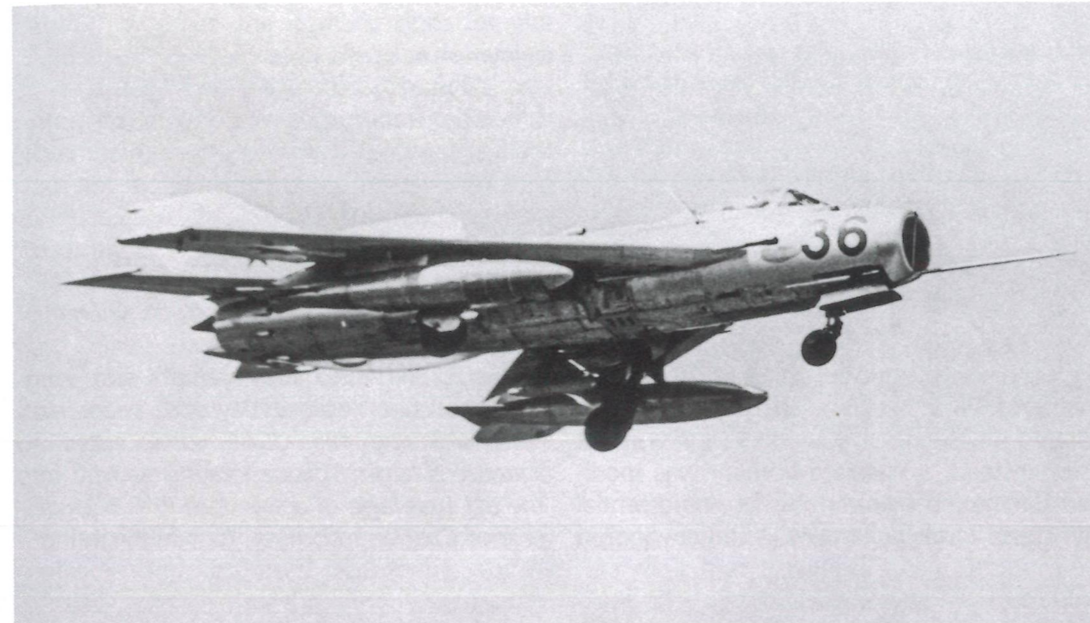
intruder was heading towards Askol'd Island at 10,000 m [32,810 ft]. In order to identify the intruding aircraft and ascertain its reasons for appearing in our waters, two of our fighters were dispatched at 0706 hrs to rendezvous with it.

At 0711 hrs the leader of the fighter pair (pilot Capt. Rybakov) sighted the intruder flying 10 km [6.21 miles] to the south of Askol'd Island; this turned out to be an American RB-50 aircraft with a red-striped tail and US Air Force insignia. As our fighters closed in to identify the intruder, they were fired upon by the latter; the lead fighter suffered damage to the port wing and the forward fuselage.' For shooting down the RB-50 Rybakov received the Order of the

'30 Blue', a typical MiG-19S in IA PVO service; note the 'barber pole' striped pitot



This MiG-19S coded '100 Blue' wears 21 mission markers



A MiG-19S in landing configuration with flaps fully deployed.

Red Banner of Combat and Yablonskiy was awarded the Order of the Red Star.

As one might imagine, the American account of the incident was totally different from the Soviet one. According to the sole survivor, John E. Roche, the Soviet fighters had opened fire without warning, knocking out two of the RB-50's engines, whereupon the aircraft dived into the sea. Roche was rescued by a US vessel after floating around in his life raft for 18 hours, and the bodies of three other crewmembers were recovered; the remaining 13 were never found. The bereaved families were told that the RB-50's crew had been killed in a flying accident but no details were disclosed – as was standard practice in such cases.

Meanwhile, the US military were receiving increasingly more alarming evidence that the Soviet Union was developing and deploying new combat aircraft, ballistic missiles, submarines and surface ships. They were eager to determine the sites where these new weapons were, or would be, fielded. One particular location causing concern in the West was the Kapustin Yar missile launch site (and subsequently space centre) in the Astrakhan' Region near the estuary of the Volga River; intelligence reports in 1953 indicated that intercontinental ballistic missiles (ICBMs) were being tested there. The White House and the Pentagon stepped up their efforts to obtain intelligence on Soviet strategic weapons systems. A decision was taken to begin systematic deep penetration flights over Soviet territory in order to conduct PHOTINT and SIGINT of military installations.

Two years earlier (in 1951) the RAF had fielded the English Electric Canberra B.2 tactical bomber – a very capable aircraft by the day's standards. Since the older western reconnaissance aircraft were becoming increasingly vulnerable to fighter attack when flying PARPRO missions, it was decided to use a special PHOTINT version of the Canberra for a secret mission to Kapustin Yar that was codenamed Project *Robin*. The Canberra was chosen because at the time the USAF had no aircraft that could provide the required per-

A MiG-19S passes overhead, showing off its sharply swept wings, the 760-litre drop tanks and the weapons pylons inboard of these.

This MiG-19S wears the legend *Otlichnyy* (Excellent [aircraft]) – a maintenance award that preceded the pentagonal 'Excellent aircraft' badge

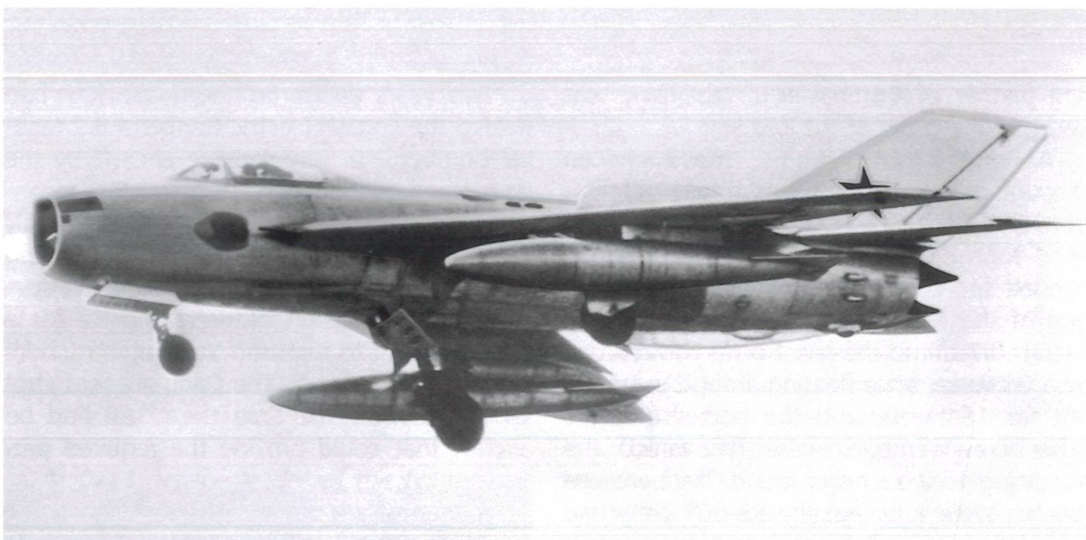
formance. Although the purpose-built Canberra PR.3 reconnaissance version had entered RAF service in March 1953, it was not used; instead, a standard bomber was modified for the job by removing all non-essential items and installing a LOROP camera with a 100-in (2,540-mm) focal length and long-range tanks in the bomb bay. A US source says *'the RAF and the USAF collaborated to squeeze a large, oblique-looking camera into the* ***aft fuselage*** *of a standard RAF B-2 twin-engine Canberra bomber'* (our highlighting – *Auth.*), whereas the camera ports of the Canberra PR.3 are located *ahead* of the wings.

Prime Minister Winston Churchill was informed of the American proposal and authorised the mission – on condition that the flight did not originate on British soil. Hence in August 1953 the freshly converted Canberra (possibly serialled WH726) took off from Giebelstadt AB in north-eastern Bavaria, West Germany, heading east across Czechoslovakia and Poland towards the Soviet Union. Its route took it via Kiev and Khar'kov in the Ukraine to Stalingrad (now Volgograd) and thence to Kapustin Yar; after completing the objective the spyplane was to exit across the Caspian Sea to Iran.

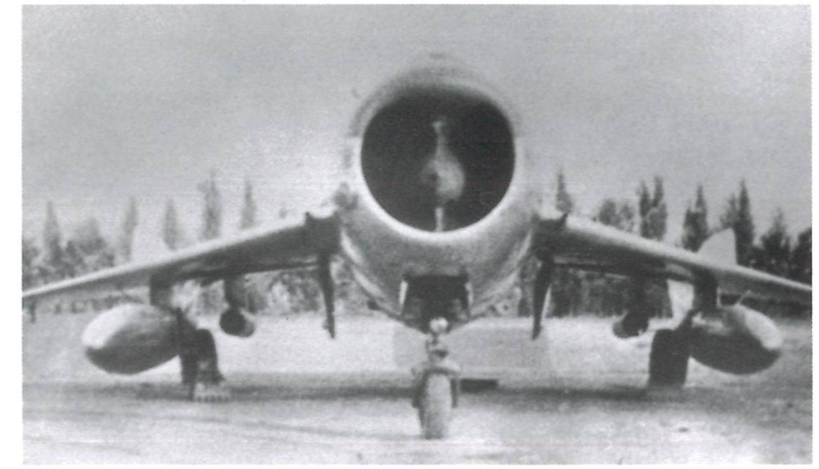
Even though the Canberra was promptly detected and accurately tracked by Warsaw Pact AD radars almost throughout the mission, the Soviet air defence system proved utterly unable to stop the intruder flying in broad daylight and climbing to 14,500 m (47,570 ft) and higher as fuel was burned off. Commenting on the event, some western authors described the response of the Soviet PVO as 'a Keystone Kops routine'. The Canberra was fired upon by anti-aircraft artillery, and fighters scrambled to intercept but most of them did not find the target, or could not climb high enough to reach it if they did. Moreover, there was an absolute lack of co-ordination between the various PVO units involved. According to a former Soviet PVO officer who defected to the West, and who had been an AD radar operator on that particular day, in the confusion some flights of fighters were vectored in the wrong direction (west instead of east); not knowing that 'friendlies' were in the air as well, the fighter flights scrambling from bases near Khar'kov found themselves attacking each other instead of the Canberra, and only sheer luck prevented a red-on-red incident. (A western author would have said 'blue-on-blue', but in the Soviet Union, and now Russia, Red Force is the 'good guys' and Blue Force is the 'bad guys'.)

While the interceptors could not shoot the Canberra down, the fighters scrambling from Kapustin Yar did manage to score a few hits in a zoom climb before stalling and losing sight of the target again. The damage was not critical but caused vibration affecting the sophisticated LOROP camera to such an extent that the coveted pictures of the test range turned out to be blurred and virtually useless. (Some

A MiG-19P comes in to land with ventral airbrake deployed.



Two blue-coded MiG-19Ps poised for take-off; note the light colour of the twin radomes. The gun blast plates near the wing roots show obvious powder stains.



A MiG-19P fully loaded with drop tanks and ORO-57K FFAR pods on pylons aft of the mainwheel wells.

The pilots of several red-coded MiG-19Ps sprint to their aircraft for a practice scramble.

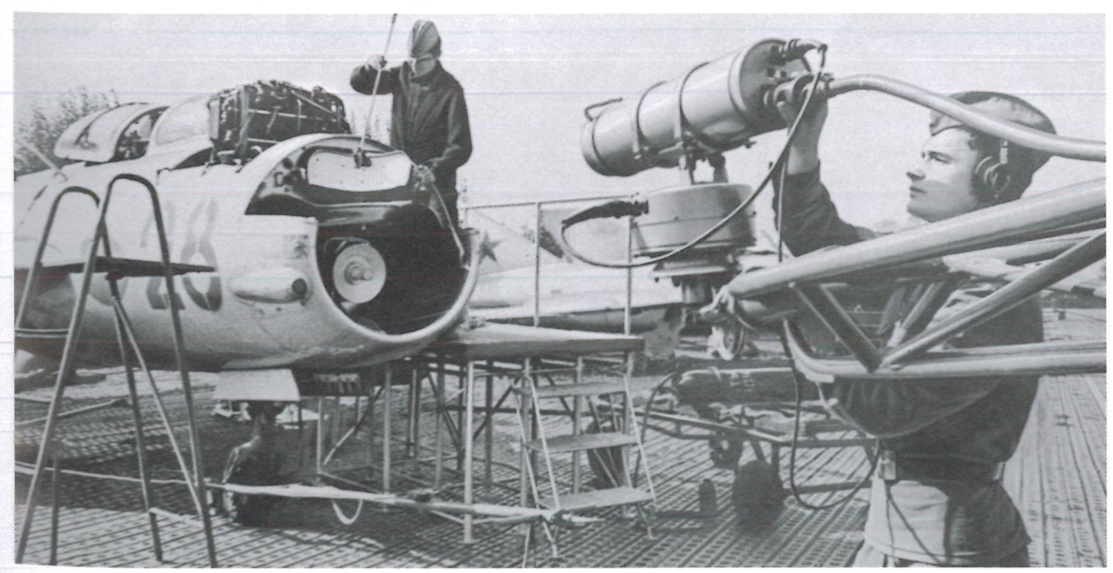
Coded '64', this *Farmer-B* is an example of the rare MiG-19PT featuring pylons for two K-13 IR-homing AAMs outboard of the drop tanks. The ventral airbrake has 'bled' down partially.

sources ascribe the honour to the AAA crews, though.) According to Robert Amory, Deputy Director of the CIA in the 1950s, the British pilot said something like *'God, never again'* after landing in Iran. After this, the RAF gave up on the idea of daylight overflights of the Soviet Union (but not overflights at large).

The Soviet Air Defence Force command considered the Canberra a difficult opponent for Soviet fighters then. In spite of ground-controlled intercept techniques making use of AD radars, the basic MiG-17F lacking an AI radar was unable to intercept in the dark. Still, the pilots scrambling to intercept the intruding Canberras were ordered to destroy them at all cost – even ram them if all else failed. Col. Nikolay Sysoyev, who commanded a fighter regiment in the Baku PVO District, reminisces: *'Really, we were not expressly ordered to ram the Canberra; however, we were recommended, as a last resort, to ram the most vulnerable parts of the bomber in such a way as not to perish in so doing'.*

Mikhail Shul'ga, another IA PVO pilot who saw service with the unit stationed in Groznyy (the capital of the Chechen-Ingush Auto-

Opposite page: MiG-19P in full attire, complete with leather helmets and map cases.



Here the MiG-19P's RP-2-U radar is undergoing calibration with the radomes removed and the radar set raised for ease of access; the emitter in front emulates radar returns from the target. Note that the hardstand is paved with perforated steel planking (PSP).

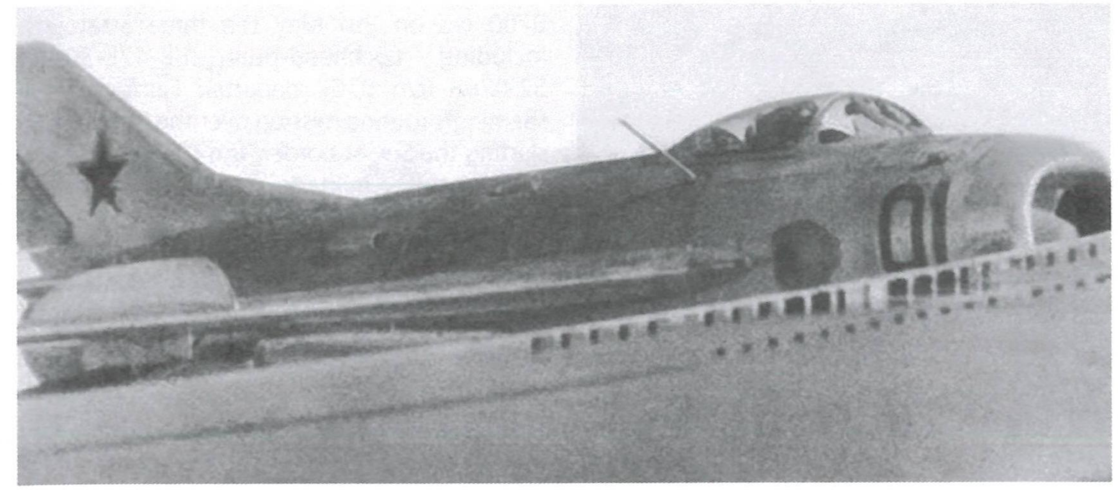
MiG-19Ps being serviced, with engine cowling panels open for inspection.

'Taxicabs to hell.' An interesting late afternoon perspective of MiG-19Ps on the flight line of a Soviet base, the 'streetlights' making the scene look a bit surreal.

nomous SSR) in 1954, recalls being scrambled one day to intercept a Canberra that had entered Soviet airspace from Iran and passed over Kapustin Yar and Groznyy before heading back to Iran. *'I climbed to 16,000 m [52,490 ft] and even succeeded in reaching 16,500 m [54,130 ft]. Ground control told me to look for the adversary aircraft above me and on my right. Sure enough, there it was, but it was flying higher than me. I tried to climb and cocked my guns, but the intruder was 1.5-2 km [4,920-6,560 ft] above my own flight level. I tried to go higher, but my fighter had reached the limit of its performance envelope. "Try another zoom climb", the tower told me, and so I tried – unsuccessfully.'*

Afterwards, RAF Canberras intruded into Soviet airspace more than once on intelligence-gathering missions.

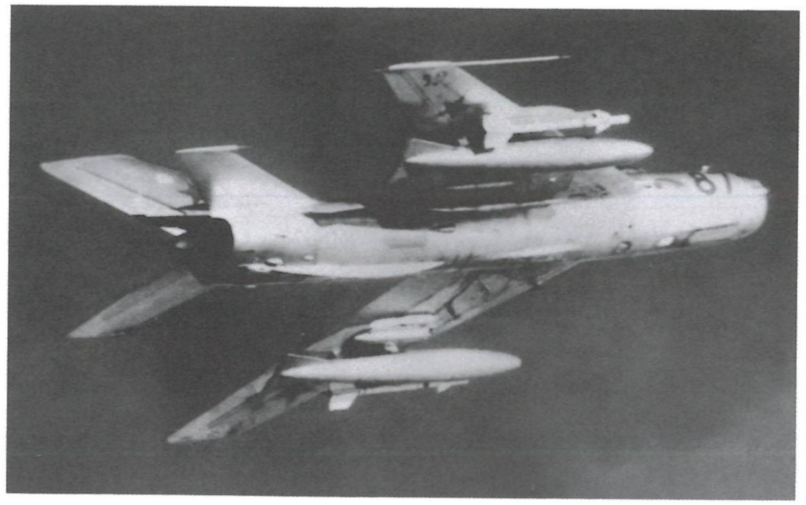
In 1954 the USAF and the RAF agreed to conduct another series of joint forays into the European part of the Soviet Union. Accordingly the Special Duty Flight was reinstated at RAF Sculthorpe once again, with much the same personnel and the same aircraft; again the RB-45Cs wore RAF markings for appearance's sake. The planned mission was virtually identical to the one flown in 1952, except that the aircraft flying the southern track – again flown by the same British crew – would make a deeper penetration into Soviet territory. The overflight was carried out



This MiG-19P was photographed by the co-pilot of an RB-47H while intercepting it over the Baltic Sea in the early 1960s.

MiG-19P '28 Red' is being worked on by apprentice technicians at a PVO Junior Aviation Specialists' School.

Here the same MiG-19P has been trestled for landing gear operation checks.



Possibly the most heavily armed *Farmer* anywhere, this MiG-19PT is carrying K-13A AAMs, ORO-57K FFAR pods and drop tanks.

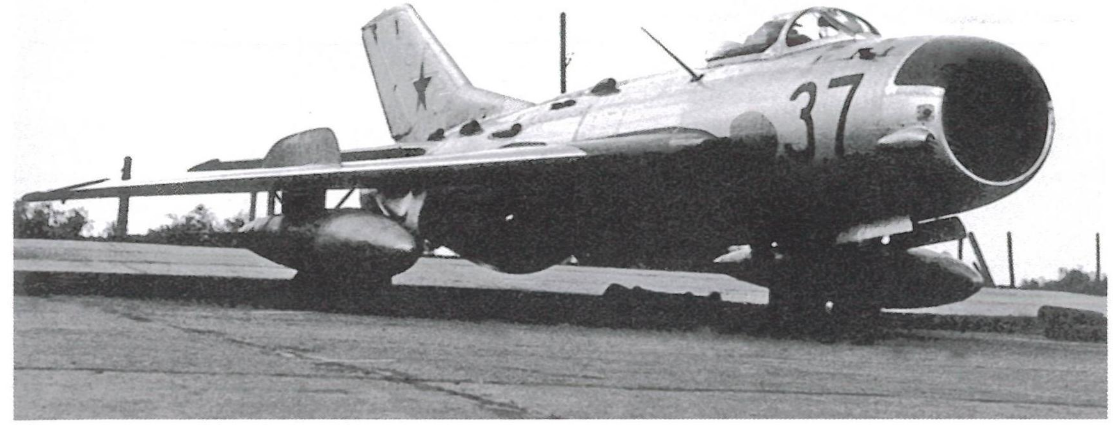
on the night of 28th/29th April 1954; the objective was not only to reconnoitre the DA bases, which were rumoured to host new Myasishchev M-4 *Bison-A* strategic bombers, but also to test the reaction of the Soviet PVO in preparation for a possible strike against the Soviet Union. The aircraft on the southern route ran into heavy flak at its flight level of 10,970 m (36,000 ft) over Kiev and had to turn back, cutting the mission short, but the other two slipped through unimpeded as far as Novgorod and Smolensk, defying the numerous fighters sent after them. This raid showed that the Soviet PVO's ability to stop a real-life NATO air strike was close to zero.

The unannounced air war at the Soviet borders (and, occasionally, inside them) continued. In mid-April 1954 the SAC dispatched three 91st SRW RB-47Es to RAF Fairford on instructions from the Joint Chiefs of Staff. At 0700 hrs on 8th May the three Stratojets, including Lockheed-built RB-47E-30-LM 52-0268 (c/n 076), departed Fairford on a seemingly routine mission over the Barents Sea skirting the Soviet border; the objective was to photograph military installations near Murmansk, Arkhangel'sk and Lake Onega. Two aircraft made a U-turn about 160 km (100 miles) north of Murmansk and headed back to England as instructed, but the crew of 52-0268 had different orders. Flown by Capt. Harold 'Hal' Austin (pilot), Capt. Carl Holt (co-pilot/gunner) and Maj. Vance Heavilin (navigator), the aircraft turned south and intruded into Soviet airspace over the Kola Peninsula. The mission was to photograph Soviet airbases in the area and find out how many of the new M-4 bombers and MiG-17 fighters had been deployed. Upon completing the objective the aircraft was to land in Norway.

Two accounts of the incident exist. According to one, shortly after passing Murmansk at noon at 40,000 ft (12,190 m) and 814 km/h (505 mph) the RB-47E was intercepted by a flight of six MiG-15s, then a little later by six more *Fagots* over the White Sea, but strangely enough they made no attempt to attack. (One source claims these were three MiG-17s, and the RB-47 took some evasive action, deviating from the desired track.) Only when the aircraft had turned west over Arkhangel'sk did the first attack come. Six MiG-17s of the North Fleet's 91st IAD/1619th IAP based at Luostari popped up and opened fire. (This regiment later became the 941st IAP – *Auth.*) Cannon shells hit the port wing and

Rear view of a MiG-19P being prepared for a sortie.

A standard MiG-19P with drop tanks.



fuselage, knocking out the intercom; Holt returned fire but the cannon jammed after the first burst. Possibly the MiGs were critically low on fuel, as they broke off the attack.

Shortly afterwards, when the Stratojet had passed Lake Onega, photographing more airbases, six more MiG-17s, this time 614th IAP aircraft, repeated the attack but also unsuccessfully. After that, the RB-47 crew thought it best to get out of harm's way and hastily crossed into Finnish airspace – incidentally, only just managing to take on fuel from a standby KC-97 tanker from RAF Brize Norton on the way home, the crew reporting there were no bombers at the bases they had seen.

According to the other story, the North Fleet's air defences simply failed to spot the intruder, which proceeded unhindered over Murmansk and Severomorsk. The RB-47 was detected only when it had crossed the Kola Peninsula and was deep inside Soviet airspace, obviously heading towards Arkhangel'sk and Molotovsk (now called Severodvinsk). A MiG-15*bis* scrambling to intercept caught up with the Stratojet and expended the entire ammo supply – 40 rounds for the N-37 cannon and 160 rounds for the two NR-23 cannons – but failed to score a hit. The spyplane overflew Arkhangel'sk and Molotovsk with impunity, the point air defences putting up no resistance, and departed towards the Barents Sea. Reprisal for this failure came quickly: Lt.-Gen. Ivan I. Borzov, Commander of the North Fleet air arm, was removed from office.

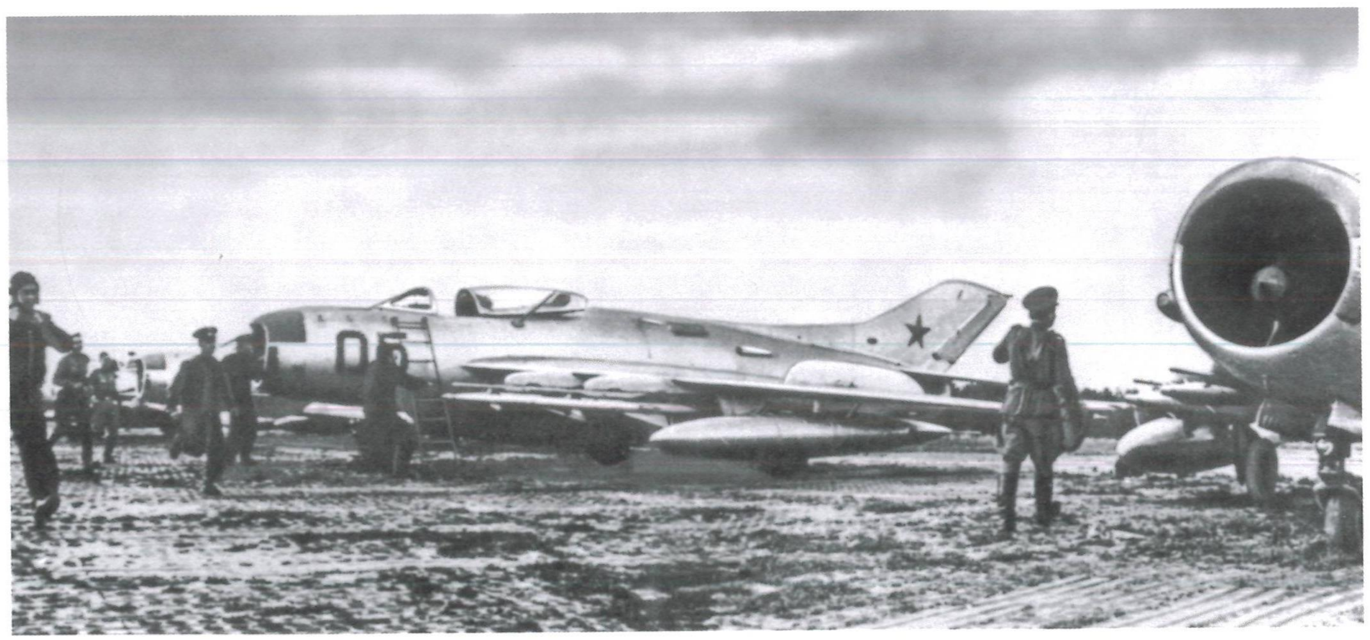
On 9th May 1954 Capt. M. Kitaïchik, the best sniper pilot of the North Fleet air arm,

Re-equipment could be a lengthy process, with old and new types serving side by side in the same unit. Here, four MiG-19PMs share the hardstand with a MiG-17F.

'Gentlemen, let's synchronise our watches.' PVO pilots are briefed in front of missile-armed MiG-19PMs and several UTI-MiG-15 trainers.

Red alert! MiG-19PM pilots of the QRA duty flight race to their aircraft.

attempted to intercept a Boeing RB-47 Stratojet near Arkhangel'sk in a brand-new MiG-17PF interceptor. After a brief exchange of fire the Stratojet, which was operating from one of the British bases, managed to get away.

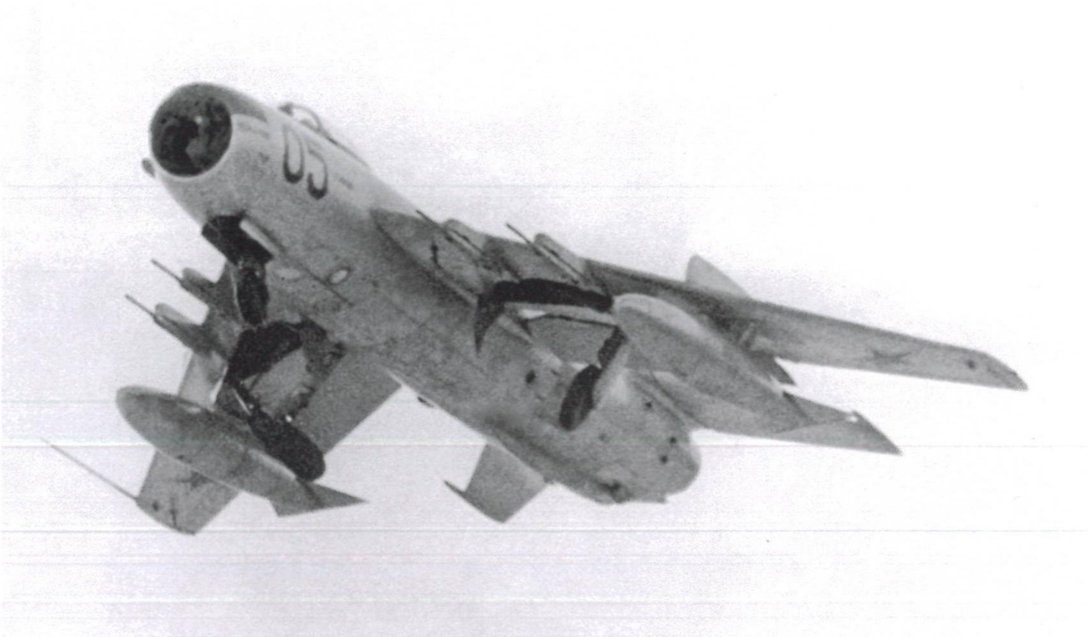


A MiG-19PM belonging to the 472nd IAP on the military hardstand at Kursk-Khalino airport.

As mentioned earlier, the foreign aircraft breaching the Soviet border were not confined to spyplanes. USAF B-47 bombers launching from European bases repeatedly penetrated into Soviet airspace as far as the Novgorod-Smolensk-Kiev line; it cannot be ruled out that some of them were actually carrying nuclear

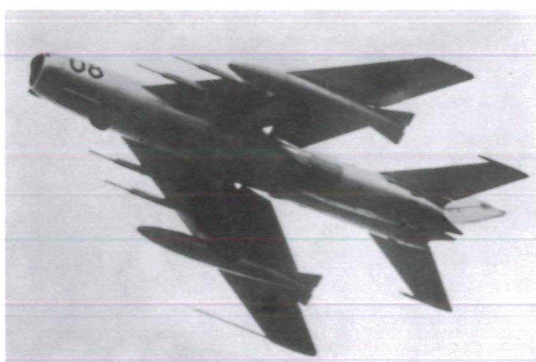
MiG-19PM '18 Blue' armed with a full complement of four RS-2-U AAMs climbs towards its target. The drop tanks have been jettisoned. Photographs of this very aircraft were widely used as a graphic illustration of the 'Soviet Threat'.

MiG-19PM '05 Blue', with empty missile rails, tucks up its landing gear as it departs on a training sortie.

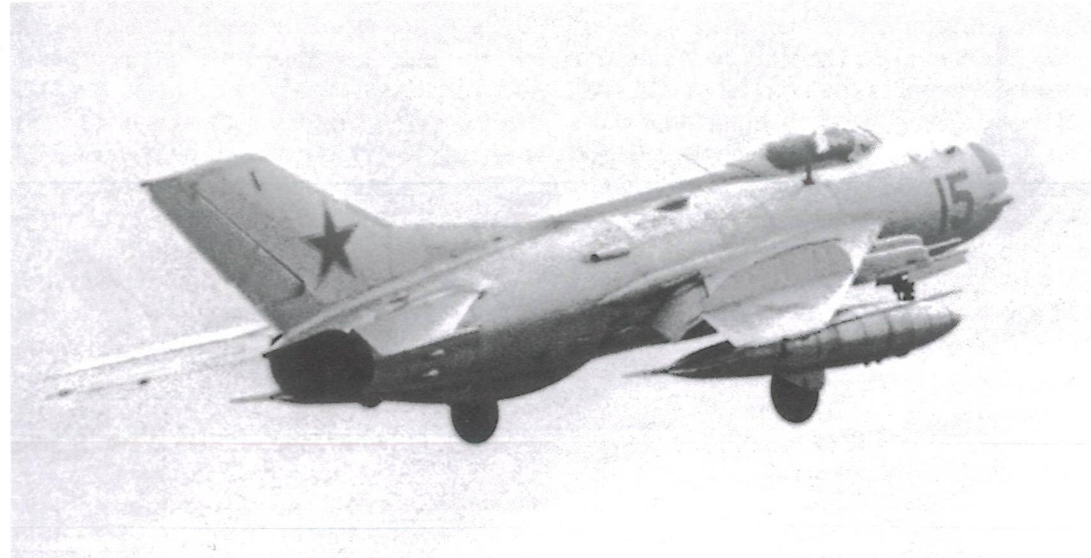


Two views of another *Farmer-D* coded '08 Blue'. This aircraft belonged to the 786th IAP based at Pravdinsk near Kaliningrad.

bombs. While the AD radars usually tracked them accurately, the PVO's weaponry of the day, and in particular the subsonic fighters of the 1950s, were no match for the fast and high-flying bombers. The Stratojets were playing a 'catch me if you can' game with the Soviet air defences, taunting them by flying in pairs, threes or even groups of six. For several years there was nothing the Soviets could do about it, as the MiG-15s and MiG-17s could not keep up with their prey. Whereas the slow piston-engined RB-50s were methodically destroyed from 1950 on, it was not until 1955 that the first RB-47 was shot down. On 18th (some sources say 17th) April that year an Boeing RB-47E Stratojet of the 4th SRS



departed Eielson AFB, Alaska, breaching the Soviet border near the Bering Islands. Two MiG-15s piloted by Capt. Korotkov and Sazhin shot down the intruder, killing the crew of

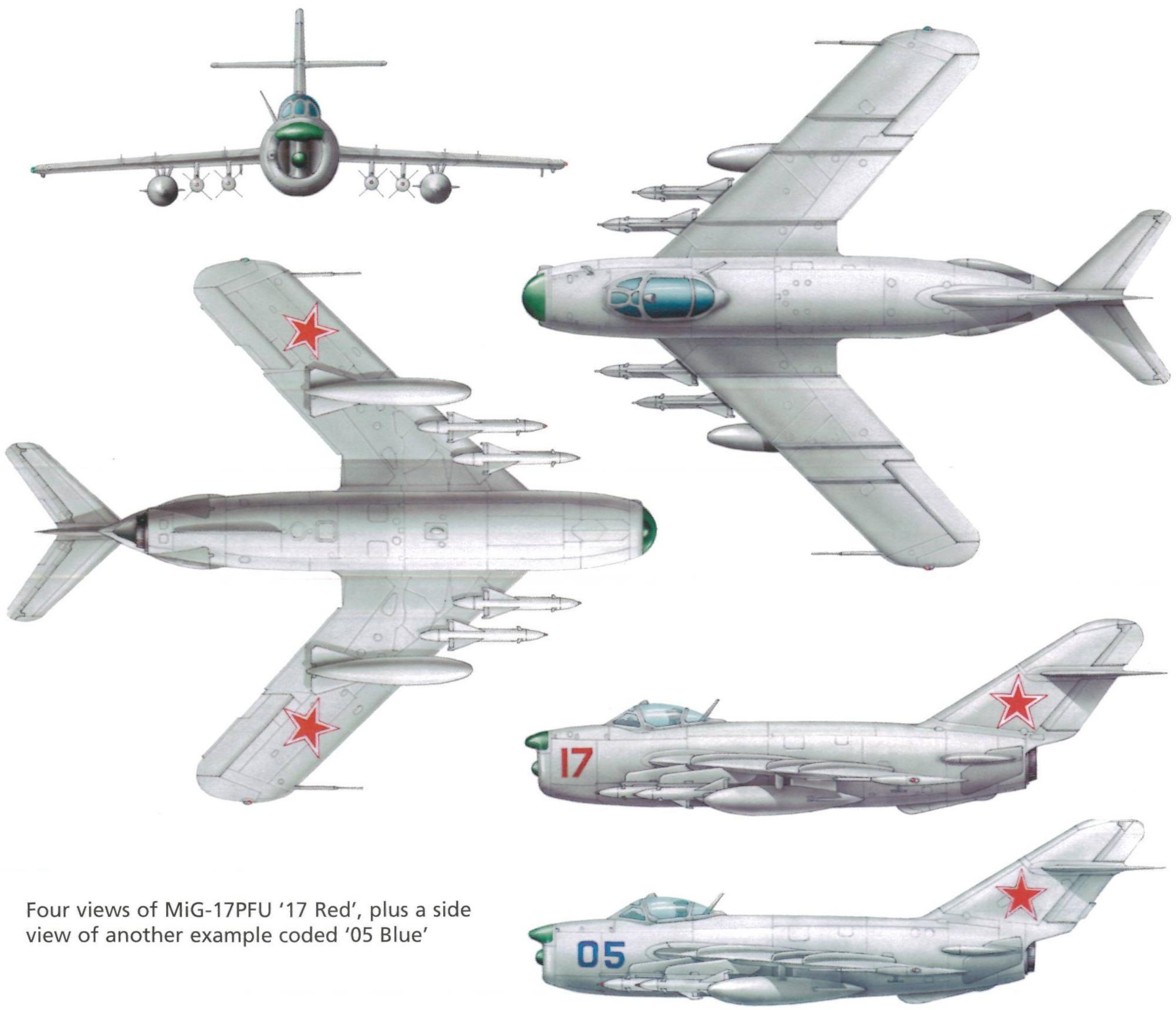


A MiG-19PM climbs away at the beginning of a training sortie, showing the large flaps.

three – pilot Lacie C. Neighbors, co-pilot/gunner Richard E. Watkins Jr. and navigator Robert N. Brooks.

In March 1953 the Soviet Armed Forces underwent yet another major reorganisation as the War Ministry and the Naval Ministry were amalgamated into the Ministry of Defence. Among other things, the post of Commander-in-Chief of the National Air Defence Force was established as a deputy to the Minister of Defence. Marshal Leonid A. Govorov became the first PVO C-in-C; in accordance with a Soviet Council of Ministers directive and an order issued by the Minister of Defence on 28th May 1954 the PVO C-in-C exercised operational control of all fighter units in the military districts into which the

This MiG-19PM coded '31' bears 13 'kill' stars scored in successful training sorties.



Four views of MiG-17PFU '17 Red', plus a side view of another example coded '05 Blue'

Soviet Union's territory was divided. On 14th June 1954 the Minister of Defence signed another order whereby the PVO regions in both the borderside regions and the inner regions were reorganised into theatre-strategic and theatre formations (PVO districts and armies), as well as theatre-tactical units (PVO corps and divisions). These included the units of the PVO's fighter arm.

As part of the mentioned reorganisation, in 1954 Col.-Gen. Yevgeniy Ya. Savitskiy was reinstated as IA PVO Commander at the insistence of First Deputy Minister of Defence Marshal Gheorgiy K. Zhookov. The latter was a popular figure in the Soviet Union, being known informally as 'the Victory Marshal' for hi part in commanding the Soviet Armed Forces during the Great Patriotic War, and enjoyed great authority and respect – greater than almost everyone else in the nation's political and military establishment. Zhookov considered Savitskiy to be the most competent and experienced person in air defence aviation matters.

Meanwhile, the overflights of the Soviet Union by NATO aircraft continued unabated. The US leaders were well aware that, though sanctioned by them (that is, not rogue operations), these incursions were in contravention of international law. The incident which took place on 7th November 1954 goes to prove this. An RB-29 entered Soviet airspace over the Sea of Japan on a routine photographic reconnaissance mission near Hokkaido Island, Japan, and the disputed southern Kurile Islands. 7th November was a major public holiday in the Soviet Union – the anniversary of the October Revolution (this is because 7th November 'new style' on the Gregorian calendar equals 25th October 'old style' on the

Julian calendar used in Russia up to 1918). Therefore the Americans counted on the Russians being full of vodka and out of condition to react; they counted wrong. Two MiG-15s flown by Kostin and Seberyakov scrambled to intercept and attacked the RB-29 over Tanfil'yev Island (one of the Kurile Islands). The seriously damaged Superfortress returned fire and got away but crashed near Nokkegun village on Hokkaido. The crew of eleven bailed out, ending up in the water; ten crewmen were successfully rescued but the eleventh man drowned after becoming entangled in his parachute lines when he splashed down. Of course, a huge anti-Soviet campaign was orchestrated in the US, accusing the Soviet fighter pilots of downing an 'innocent' US aircraft. Senate Republican Leader William Fife Knowland called on President Dwight Eisenhower, demanding that the USA break off diplomatic relations with the USSR, with reference to broad public demand. However, using carefully worded phrases, the president made it clear that the flight of the RB-29 had been anything but innocuous.

Gradually Soviet fighter pilots built up experience in dealing with the intruders; as the PVO's fighters and AD radars became more sophisticated, so did the operational techniques used for intercepting fast and high-flying hostile aircraft. Still, far from all scrambles to intercept a target ended in success, occasionally leading to tragic errors and losses.

On a summer day in 1954 an American reconnaissance aircraft operating from Japan entered Soviet airspace near the seaport of Nakhodka (the name means 'The Find') east of Vladivostok and was 'painted' by Soviet radars. Immediately afterwards the intruder descended to low level and made off, which the AD radar operators failed to notice. Unfortunately, a group of Pacific Fleet/46th MTAP (***min****no-tor****ped****nyy* ***a****via****polk*** – aerial minelayer and torpedo-bomber regiment) Tupolev Tu-14T *Bosun* torpedo bombers was returning from a training sortie at that very moment – and by the greatest bad luck the rearmost aircraft's IFF transponder was out of order. The PVO officers decided that the intruder was tailing the torpedo-bombers, and Capt. Pyotr Byvshev (32nd IAD/535th IAP) was ordered to intercept it. Spotting a 'twinjet aircraft of unknown type with no identification markings', as he reported, Byvshev received the order to fire and shot down the Tu-14 with his first burst; there were no survivors among the crew of three.

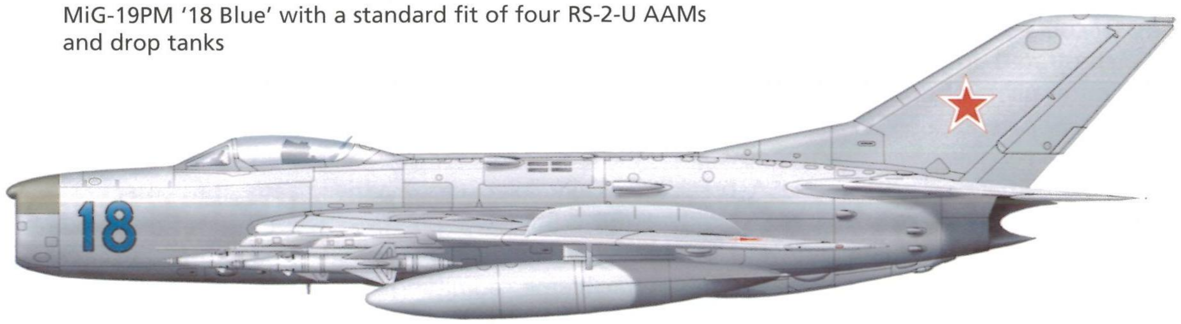
Only later did Byvshev learn the bitter truth. Still, no punitive action was taken against him; the commanders had to accept the blame, admitting that the Tu-14, which was built in small numbers for the Soviet Navy, was unfamiliar to Air Force and PVO personnel. Also, the star insignia were barely visible, not to mention the malfunctioning IFF transponder. Incidentally, Capt. Byvshev was killed in an accident soon afterwards, colliding with high ground in poor weather when returning from another sortie. Call it fate's revenge, if you like.

On 4th September 1954 a US Navy Lockheed P2V-5 Neptune of VP-19 operating from Naval Air Station Atsugi, Japan, was attacked by two MiG-15s some 64 km (40 miles) off the Soviet coast. The aircraft ditched and one crew member, Roger H. Reid,

Colour photos of operational MiG-17PFs are rare. This one was published in the monthly magazine *Sovetskiy Voïn* (Soviet Warrior).

This 401st IAP MiG-19PT was one of 45 deployed to České Budějovice during the Soviet invasion of Czechoslovakia in August 1968, gaining 'invasion stripes' for the occasion

MiG-19PM '18 Blue' with a standard fit of four RS-2-U AAMs and drop tanks



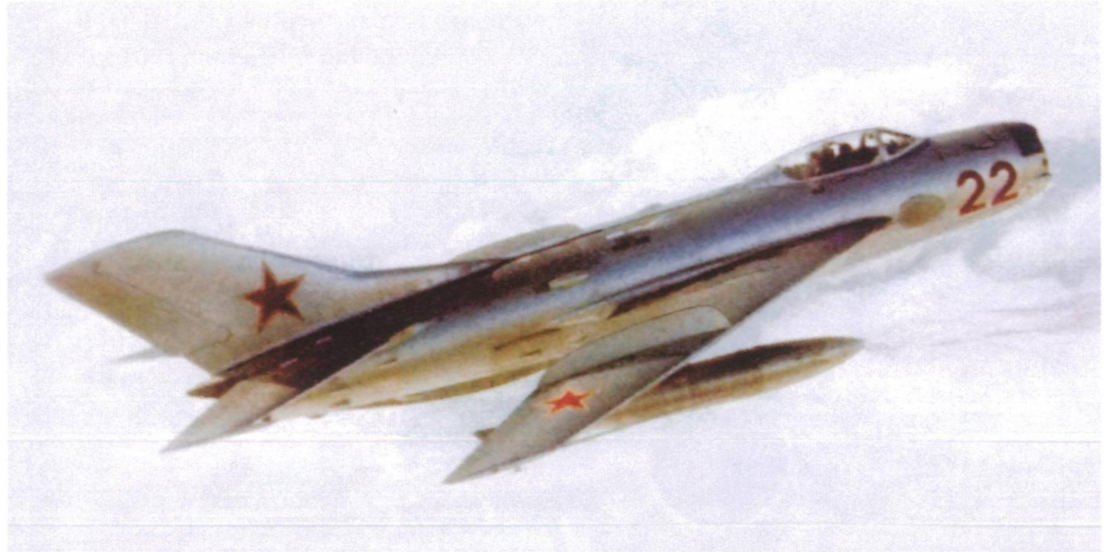
IA PVO aircraft normally had blue tactical codes, but some units had red ones, as exemplified by MiG-19PM '35 Red'

lost his life. The rest of the crew (John B. Wayne, John C. Fischer, William A. Bedard, Frank E. Petty, Anthony P. Granera, Texas R. Stone, Paul R. Mulmollem, Ernest L. Pinkevich and David A. Atwell) were rescued by a US Air Force Grumman SA-16 Albatross amphibian.

In spite of the possible political complications and outright military confrontation with the Soviet Union that could arise from the overflights, the US intelligence community had no intention of stopping them. New tactics were devised to increase the scope of the information obtained and avoid putting the aircrews' lives at risk.

On 1st May 1955 (it's uncanny how the overflights were timed to Soviet public holidays – perhaps in the hope of less vigilance from the Soviets) NATO reconnaissance aircraft overflew many Soviet cities in Europe, including Leningrad and Kiev. They actually took pictures of the May Day parades (which occasionally included military hardware, despite the ostensibly peaceful nature of the holiday); the Soviet workers attending the parades had no idea they had such 'support from the sky'! On the other hand, this sure 'pepped up the party' for the PVO personnel, including IA PVO and radar crews!

On 22nd June 1955 a US Navy/VP-19 P2V-5 (BuNo 131515) flying a patrol mission from Kodiak, Alaska, was attacked and damaged by a MiG-15 over the Bering Strait. (One source states the unit as VP-9.) With one engine on fire, the aircraft crash-landed on St. Lawrence Island in the Bering Sea. Of the eleven crew members, including pilot Richard F. Fischer, co-pilot David M. Lockhard, Donald E. Sonnek, Thaddeus Maziarz, Martin E. Berg,



MiG-19P '22 Red' with drop tanks flies above thick overcast.

Eddie Benko, David Assard and Charles Shields, four sustained injuries due to gunfire and six were injured during the landing. The USA demanded $724,947 in compensation; the USSR ultimately paid half this amount. According to some sources, the MiG pilot did not make it back to base, running out of fuel and ejecting near the coast of Chukotka.

In March 1955 there was one more overflight of the Soviet Union by three RB-45Cs originating from RAF Sculthorpe. This time they wore USAF markings and the mission was led by Maj. John Anderson. The routes and targets were nearly identical to those of earlier RAF flights, though this time the Ukraine track was farther to the south. The mission objective, as before, involved radarscope photography of Soviet military installations and cities for NATO target folders. Soviet fighters again scrambled into the night sky but could not locate the reconnaissance aircraft in the darkness; the RB-45Cs returned safely, landing in West Germany. Again, the crew members received Distinguished Flying Crosses.

In July 1956 a group of 7th IAD (Pacific Fleet) MiG-15s attacked another P2V near Nakhodka, killing one crew member. The damaged Neptune ditched in the Sea of Japan and sank; the remaining crew was rescued by a US Navy rescue team.

In 1956 the USAF's reconnaissance units started taking delivery of RB-47E and RB-47H aircraft equipped with more advanced aerial cameras and ELINT systems. In March-May 1956 such aircraft operated from the auxiliary base at Thule, Greenland, flying missions across the North Pole, to the Kola Peninsula, Novaya Zemlya ('New Land') Island and the Bering Strait. The results of these sorties confirmed what the US military already knew; the northern borders of the Soviet Union had a sparse radar network and were ill protected by PVO assets. Also in 1956, NATO sent drifting reconnaissance balloons *en masse* from West Germany and Turkey; they were to cross the Soviet Union from west to east and be picked up over the Pacific Ocean. Yet the operation brought scant results; only 44 of the 516 balloons (!) reached the Sea of Japan, the rest being destroyed by Soviet interceptors. Capt. L. I. Savichev was the first MiG-17 pilot who managed to shoot down such a balloon, destroying his quarry with just nine cannon shells at 10,000 m (32,810 ft) near the city of Chernovtsy in western Ukraine. A few days later Savichev took off again to intercept a reconnaissance balloon but could not destroy it, despite expending the entire ammo supply – the balloon was flying too high.

Still, many incursions were carried out with impunity. In 1953-56 US civil and military aircraft alone intruded into Soviet airspace on 113 occasions, not counting the aircraft operated (whether actually or nominally) by other nations.

Also in 1956, the USAF and the CIA carried out one of their most notorious reconnaissance operations against the Soviet Union known as Operation *Home Run*. Between 21st March and 10th May several 55th SRW RB-47s of different sub-variants made at least 156 deep-penetration flights over Soviet territory near the Kola Peninsula, the Urals Mountains and Siberia. The operation involved 21 reconnaissance aircraft and up to 15 refuelling tankers; the latter extended the Stratojets' range from 6,500 km (4,040 miles) to 9,400 km (5,840 miles) with one top-up, or

even more if the aircraft was refuelled multiple times. Again operating out of Thule, the RB-47s took a cross-Polar route to the target, rendezvousing with the tankers that were stationed at Fairbanks, Alaska. On some occasions the Stratojets used up more fuel (by weight) than their own take-off weight.

By then the IA PVO had begun fielding the Yak-25 and Yak-25M all-weather patrol interceptor, but the *Flashlight-A* was still scarce and, to top it all, was markedly inferior to the Stratojet in service ceiling, being optimised for low-altitude operations. The same was partly true for the MiG-19P all-weather interceptor which had entered production in 1955; it could match the performance of the RB-47, but the *Farmer-Bs* were still few and had been mastered only by a few dozen service pilots, serving with a few selected regiments. The more widespread MiG-19 and MiG-19S *Farmer-A/C* day fighters operated by the Air Force and the IA PVO had the performance but lacked radar, which made using them against the Stratojet pointless. Conversely, the MiG-17P and MiG-17PF *Fresco-B/D* had radar but lacked the speed and altitude performance required to oppose the Stratojet.

On 4th-9th July 1956 the Americans gave an especially blatant demonstration of the Soviet PVO's inadequacy. The RB-47s made daily incursions of up to 350 km (217.5 miles) into Soviet airspace, approaching from Poland or the Baltic Sea. In so doing they photographed the Baltic Fleet base at Kaliningrad and various military infrastructure on the shore. Again, the IA PVO proved incapable of stopping any one of these incursions, even though the Americans followed the same pattern each time – which is usually punishable.

On 11th December 1956 three USAF Martin RB-57D-0 reconnaissance aircraft from a special detachment based at Yokota AB in Japan entered Soviet airspace near Vladivostok simultaneously at three different locations to overfly three different targets. Contrary to Air Force hopes, the bombers were picked up on Soviet radar, and MiG-17s scrambled to intercept them. Even though the RB-57s were out of reach, the fighter pilots identified the type positively, and on 14th December the Soviet government filed a formal protest:

'On 11th December 1956, between 1307 and 1321 o'clock, Vladivostok time, three American jet aircraft, type B-57, coming from [...] the Sea of Japan, south of Vladivostok, violated the airspace of the Soviet Union. [...] Good weather prevailed in the area violated, with good visibility, which precluded any possibility of the loss of orientation by the fliers during their flight. [...] The Government of the Soviet Union [...] insists that the Government of the USA take measures to punish the guilty parties and to prevent any future violations of the national boundaries of the USSR by American aircraft.'

Above: A retouched photo of a pair of MiG-19PMs ('04 Red' and '05 Red') with a full load of AAMs flying a practice intercept sortie. Photos like this one were common in Soviet magazines.

Above left: A pair of MiG-19PMs taxies out for take-off. No missiles are carried, indicating this is a training sortie.

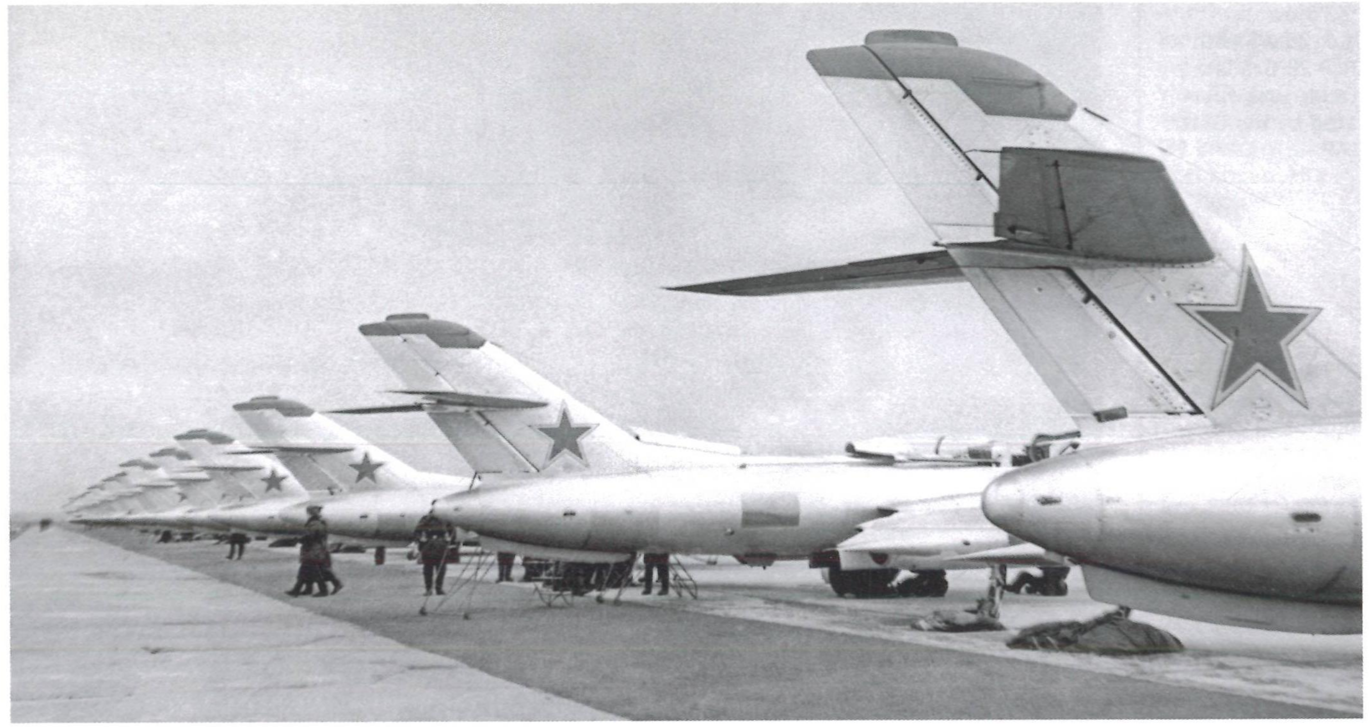
Left: An interesting mix of subsonic MiG-17PFUs and supersonic MiG-19PMs on the flight line of a PVO unit in the southern regions of the Soviet Union (as indicated by the 'tropical-style' uniform of the armourers pulling the dolly in the foreground. The dolly is loaded with RS-1-Us and RS-2-Us for both types, facing alternatively left and right; note the protective covers over the threaded holes for the fuses.

A Yak-25 *sans suffixe* with the pre-1955 style serial '055 Red'

Another Yak-25 *sans suffixe* serialled '069 Red' (c/n 0906)

There is one more strange episode associated with US incursions into Soviet airspace and the Soviet air defence system's futile attempts to stop them. On 10th September 1957 the Americans undertook one of their most mysterious reconnaissance operations in Soviet skies. An unspecified high-altitude aircraft originating from a base in Iran flew over the Caspian Sea and followed a 3,050-km (1,895-mile) route that took it over Stalingrad, Armavir, Groznyy and Tbilisi before returning to Iran. In so doing it reconnoitred the missile test centre at Kapustin Yar and the aircraft weapons test range at Vladimirovka AB (now known as Akhtoobinsk) in the Astrakhan' Region near the estuary of the Volga, which was home to the Soviet Air Force Research Institute (NII VVS – *Na**ooch**no-is**sled**ovatel'skiy insti**toot** Vo**yen**no-voz**doosh**nykh seel*). (The former NII VVS is still located there and is currently called the Russian MoD's 929th State Flight Test Centre.) When the aircraft was 100 km (62 miles) from Vladimirovka, an unidentified object allegedly separated from it and quickly vanished from Soviet AD radar coverage, accelerating to 1,800 km/h (1,118 mph); it appeared that the intruder had simulated a stand-off missile launch against a ground target. Despite an extensive search by the search and rescue components of the Soviet Armed Forces, no debris of the missile (or whatever it was) could be found.

Five early-production Yak-25 interceptors ('129 Red', '089 Red', '069 Red', '099 Red' and '209 Red') make a flypast at the 1955 May Day parade.



An impressive row of Yak-25M interceptors.

In the spring of 1958 the Americans once again sent 'May Day greetings' to the Soviet people. This time the RB-47s brazenly passed not only over Kiev but even over the nearest suburbs of Moscow. By then the Moscow PVO Zone had been set up, with the recently fielded S-25 surface-to-air missiles (NATO SA-2 *Guideline*) deployed around its perimeter. However, the SAM system, which was (in theory) capable of engaging up to 1,000 enemy aircraft at a time, simply failed to detect the intruders. Nor were they detected by the dozens of interceptors scrambling all across the European USSR that day.

By the mid-1950s the US command had realised that the principal institutions and installations associated with the development and testing of Soviet nuclear weapons and missile systems were located deep inside the country, in places which were increasingly hard to reach for existing spyplanes. A new, more capable reconnaissance aircraft was required; it presently materialised and entered USAF service as the Lockheed U-2. Flights of the U-2 over the Soviet Union began in 1956 and continued until 1960 when the widely publicised Powers incident put a stop to them (see next chapter).

In 1956 a MiG-17 pilot flying near Moscow spotted a U-2 cruising leisurely above him at around 20,000 m (65,620 ft). Of course, he attempted an attack but failed – the MiG's service ceiling was much lower. On landing the pilot reported the encounter but his commanders refused to believe him, as the Soviet military top brass was still unaware of the U-2's existence at the time. To make matters worse, AD radar operators hadn't noticed a thing. On later occasions the radars briefly

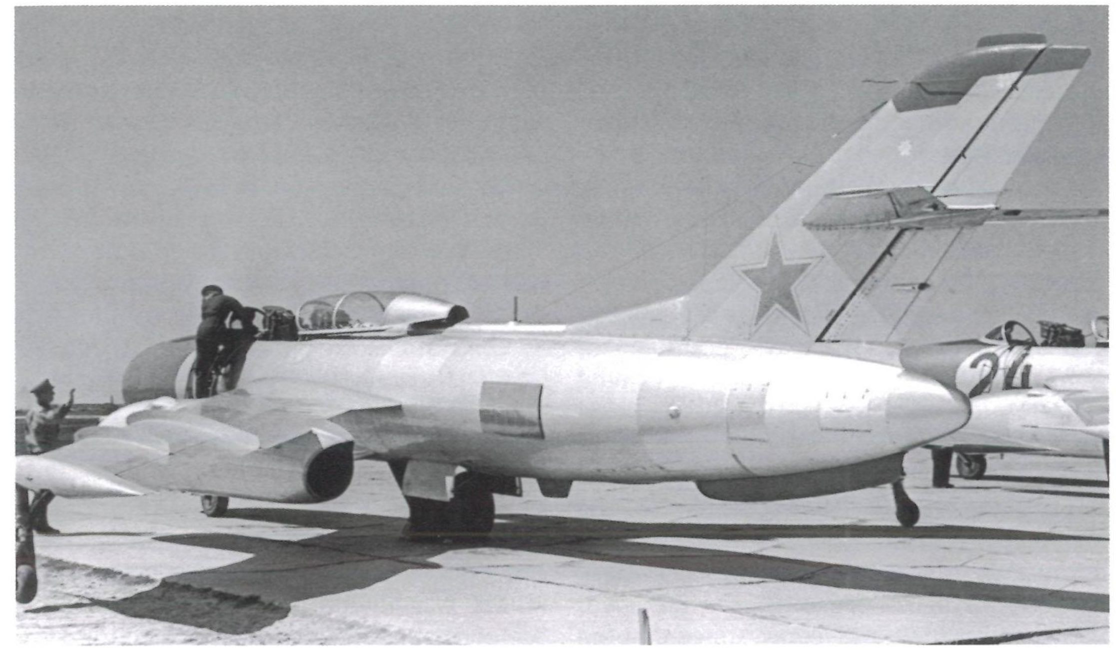
A Yak-25M with a dark grey radome comes in to land, showing the ventrally placed twin cannons and the large wing flaps.

'32 Blue', a Yak-25MG with an RLP-25 Granat radar, was operated by the 611th IAP.

611th IAP Yak-25MGs on the flight line at Dorokhovo AB sometime between 1955 and 1957.

Yak-25M '01 Red' with pale grey radome

Yak-25MG '03 Blue' with dark grey radome, 611th IAP, Dorokhovo AB, Bezhetsk, Moscow PVO District



Another view of the pristine-looking 611th IAP Yak-25MGs, including '24 Blue', at Dorokhovo AB.

Pilots and WSOs gather beside Yak-25Ms operated by another unit. These aircraft have the standard Sokol radar.

One more aspect of '24 Blue' and another 611th IAP Yak-25MG.

detected a high-flying target – no doubt a U-2 – but could not track it for an extended time.

In 1957 a pair of 17th IAP MiG-17Ps tried to catch up with a U-2 over the Soviet Far East but, of course, failed. That same year a 9th GvIAP pilot reached the MiG-17's ceiling in pursuit of a U-2; still, that was all he could do – the target flew serenely on at around 20 km, well out of range of the MiG's guns.

A 1950s vintage 'Excellent Local PVO Serviceman' enamel badge

The first encounter between the MiG-19 and the U-2 was likewise in the autumn of 1957 in the Turkestan Military District when a squadron leader of the 9th GvIAP scrambled to intercept a high-flying intruder. After climbing to 17,000 m (55,770 ft) the pilot reported sighting an unfamiliar 'cruciform aircraft' flying some 3,000 m (9,840 ft) higher. Shortly afterwards the PVO C-in-C, Col.-Gen. Yevgeniy Ya. Savitskiy, visited the unit and, upon hearing the pilot's report, stated that the pilot was 'seeing things' because the adversary had no aircraft capable of flying that high! The pilot was transferred to another unit soon afterwards. (Moral: if you can't shoot it down it doesn't exist.)

The 'Excellent PVO Serviceman' enamel badge (the early version issued in the 1950s)

On 27th June 1958 a USAF Douglas C-118 Liftmaster transport (the military version of the DC-6 airliner; the type is sometimes reported in error as a Fairchild C-119 Flying Boxcar) with a crew of nine crossed the Soviet border near Yerevan, Armenian SSR; the aircraft was reportedly on a regular supply flight from Wiesbaden, West Germany, to Karachi, Pakistan, via Cyprus and Iran. Two 34th VA (*vozdooshnaya armiya* – air army) MiG-17Ps piloted by Capt. G. F. Svetlichnikov and Capt. B. F. Zakharov intercepted the intruder 30 km (18.6 miles) south of Yerevan, ordering it to land and opening fire when the C-118 refused to comply. Five crew members parachuted to safety and four others attempted an emergency landing on a half-finished airstrip 170 km (105 miles) from the border; however, the attempt was unsuccessful and the C-118 was destroyed in the ensuing crash landing. The crew (Dale D. Brannon, Luther W. Lyles, Robert E. Crans, Bennie A. Shupe, James T. Kane, James N. Luther, James G. Holman, Earl H. Reamer and Peter N. Sabo) escaped unhurt but were captured and handed over to US representatives on 7th July.

A later version of the same badge (issued in the 1960s)

On 7th November same year two 30th VA MiG-17s attacked and damaged an RB-47 over the Baltic off Ventspils, Latvia. The spyplane managed to escape into international airspace but it may have ditched and sunk for all we know.

On 26th July 1958 an RB-47E operating from Iran was intercepted by Soviet fighters over the Caspian Sea 210 km (130 miles) east-southeast of Astara, Azerbaijan. The Stratojet evaded the fighters and fled to safety.

On 2nd September 1958 Soviet MiG-17 pilots shot down an ELINT-configured US Air Force Lockheed C-130 Hercules transport that had intruded into Soviet airspace over Armenia; the crew of 17 was killed.

On 31st October 1958 an RB-47E entered Soviet airspace over the Black Sea and was attacked by MiG-17s. Another clash between an RB-47E and MiG-17s took place over the Baltic Sea east of Gotland Island On 7th November 1958 when the Stratojet dropped in to say 'happy October Revolution anniversary', no doubt. Ten days later yet another RB-47E was intercepted by MiG-17s over the Sea of Japan. In all three cases the Stratojet's crew of three were not injured and the aircraft returned safely to base.

Western publications have repeatedly stated that US reconnaissance aircraft made approximately 1,000 incursions into Soviet airspace in 1950 and that the figure rose to 3,000-plus in 1959. Overall, in the course of three decades (1950s through 1970s) American aircraft breached the Soviet border more than 20,000 times, photographing more than 3,000,000 km^2 (1,158,300 sq miles) of Soviet territory in all. *US News & World Report* conceded that at least 252 US airmen were shot down (mostly by interceptors) during clandestine operations over the Soviet Union within this time frame; 24 of them perished, 90 survived and the remaining 138 were officially listed as missing.

USAF and US Navy aircraft were not the only NATO spyplanes to test the Soviet air defences and be dealt with accordingly. On 13th June 1952, the same day as the RB-29 shootdown in the Far East, Soviet Navy MiG-15s gained notoriety in the so-called Catalina Affair. A Swedish Air Force Douglas C-47-DL (SweAF designation Tp 79) had been pestering Soviet air defences for quite a while. The aircraft, serialled 79001 (c/n 9001) and named 'Hugin' after one of Odin's ravens from Norse mythology, officially belonged to the so-called 6 *Transportflyggruppen* (Transport Air Group) of F 8 *Flygflottilj* (Air Wing) based at Barkarby near Stockholm. In reality, it and sister ship 79002 'Munin' were used for SIGINT duties. The mission equipment operators belonged to the FRA (*Försvarets Radioanstalt* – Defence Radio Establishment).

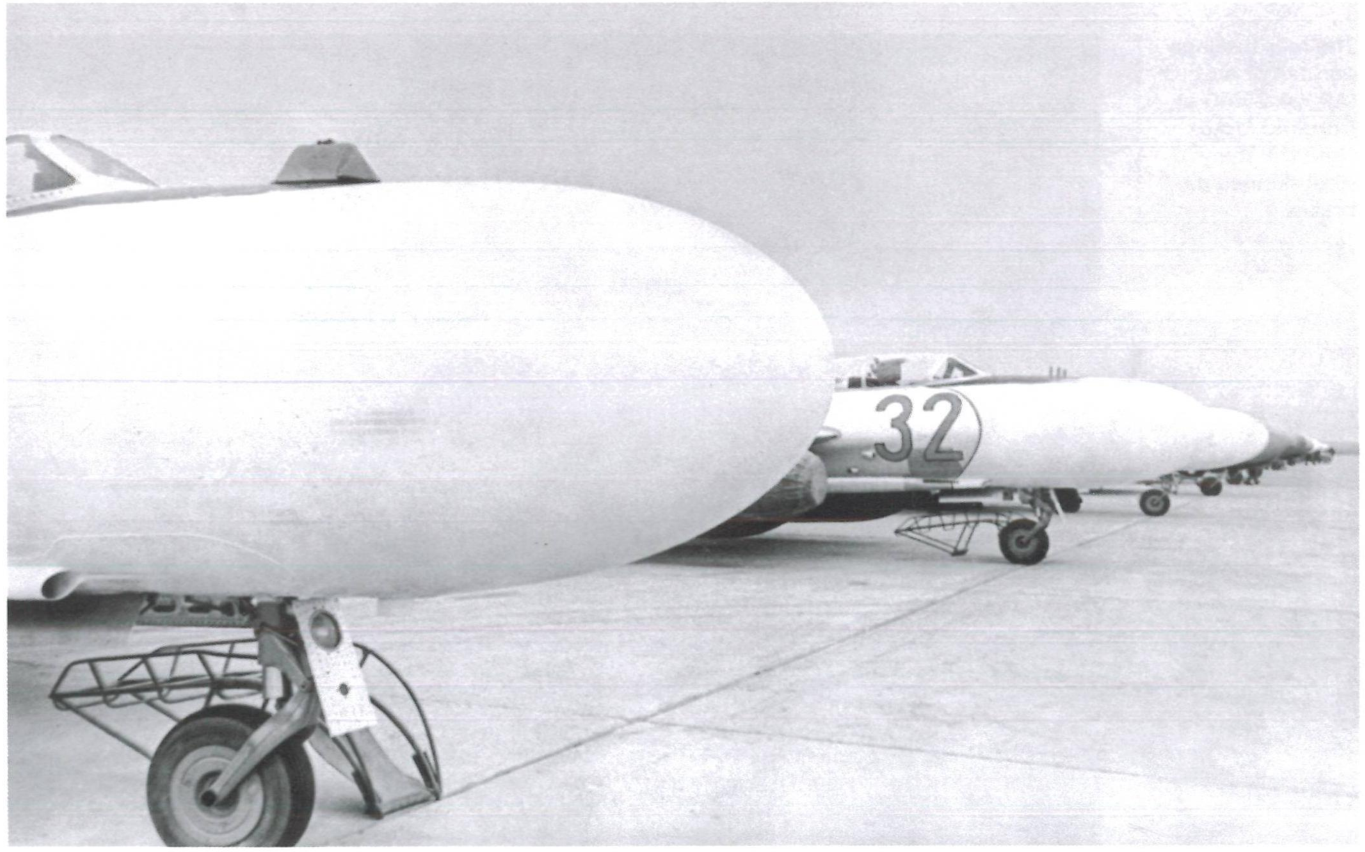
That fateful day the C-47, which was totally devoid of markings, was carrying out an electronic eavesdropping mission over the Baltic Sea near Ventspils, Latvia, where a new Soviet Navy Type 86*bis* light cruiser (NATO reporting name 'Sverdlov class') was moored at the time. A Baltic Fleet/483rd IAP MiG-15 piloted by Capt. Boris Osinskiy intercepted the spyplane and dispatched it with a burst of cannon fire. The C-47 crashed and sank in international waters east of Gotland Island; all eight crew members – pilot Alvar Älmeberg, navigator/radio operator Gösta Blad, flight engineer Herbert Mattson, mission crew leader Carl-Einar Jonsson and equipment operators Ivar Svensson, Erik Carlsson, Bengt Book and Börje Nilsson – lost their lives.

A search and rescue operation was mounted involving two Consolidated PBY-5A Catalina amphibians (SweAF designation Tp 47). At the time the search turned up nothing more than a life raft with shrapnel damage indicating a shootdown. On 16th June one of the Catalinas (serialled 47002) was likewise intercepted by MiG-15s; pilots N. Semernikov and I. Yatsenko-Kosenko attacked it and shot it up so badly that the Catalina force-landed off the island of Dagö and sank. The crew of five was rescued by the West German merchant ship M/V *Münsterland*.

A huge war of words and lies began; the Swedish government accused the Soviet Union of downing an aircraft on an innocent training mission, while the Soviet government denied any connection to the disappearance of the C-47. Later, the Soviet leader Nikita S. Khrushchov admitted the shootdown in a meeting with the Swedish Prime Minister Tage Erlander; however, this information was not made public at the time, and only in 1991 did Russia officially acknowledge the destruction of the C-47. On 10th June 2003, Swedish searchers found the wreckage of 79001 on the seabed; it was subsequently recovered during the night of 19th/20th March 2004 and returned to Sweden.

Thus, it must be acknowledged that for almost a decade (that is, almost throughout the 1950s) the Soviet Union lacked not only an effective national air defence but also effective point air defence of strategically important areas. Despite huge expenditures from the Soviet defence budget, the technological ascendancy of the NATO nations (first and foremost the USA) was such as to allow them to reconnoitre virtually whatever areas they wanted with high efficiency and largely unimpeded. Quite apart from this, the rather unwieldy ground-controlled intercept (GCI) system meant that in the time it took

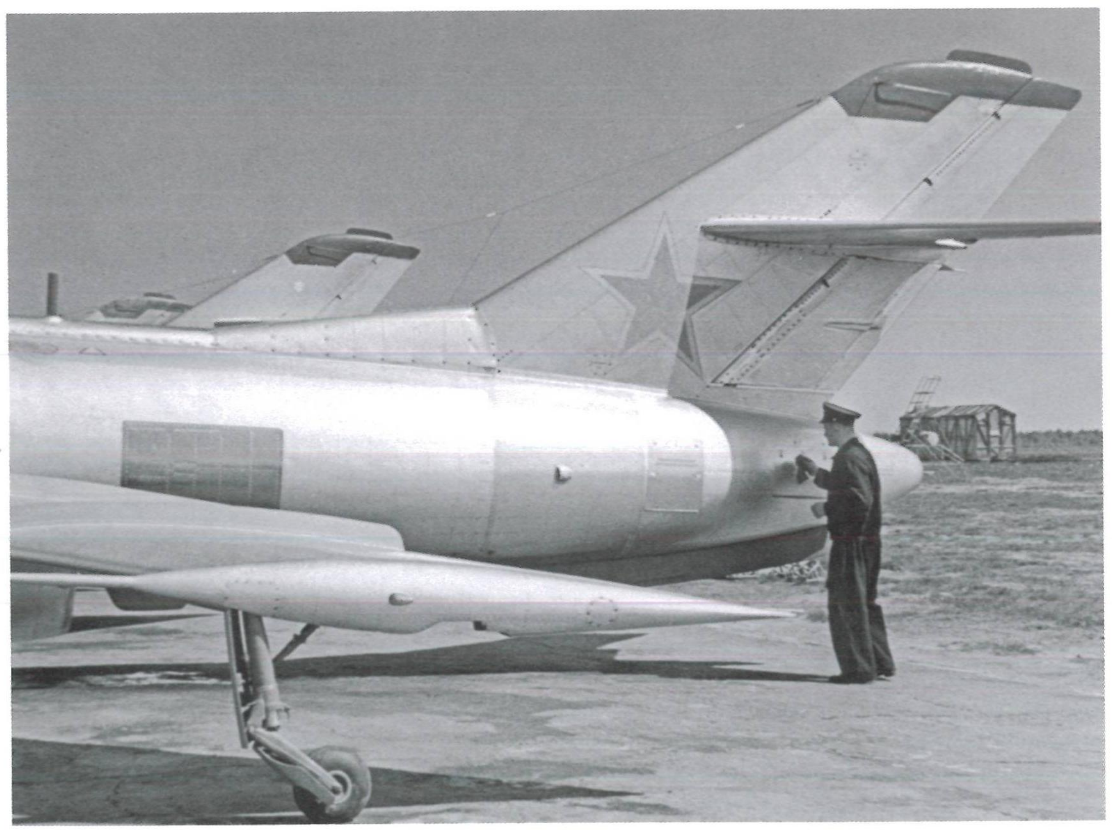
This flight line shows a mix of white- and grey-nosed Yak-25Ms. The nearest aircraft has a ground cover over the IFF aerial.



A crewman examines the cockpits of a Yak-25MG at Dorokhovo AB.

the target information to be passed along the chain of command and ultimately transmitted to the fighter pilot, the intruder would travel a sizeable distance and make confusing manoeuvres; as a result, the pilots ended up looking for the target in the wrong area.

The intensity of PARPRO operations, the frequency and depth of the incursions into Soviet territory mounted steadily throughout the 1950s; the situation was nothing short of disastrous. Still, by the end of the decade the Soviet defence industry managed a technological leap that reversed the situation in favour of the Soviet Union during the next decade.



The rear fuselage and tail of a 611th IAP Yak-25MG at Dorokhovo AB. Note the shiny steel-skinned airbrakes.

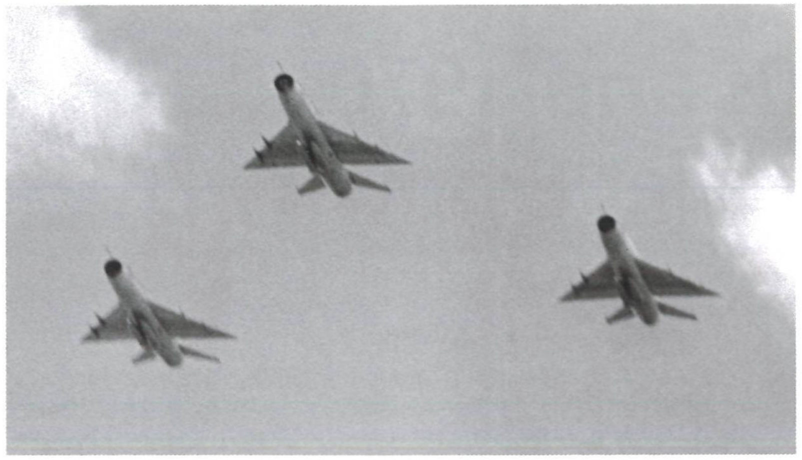
3 The 1960s and 1970s: Guarding the Soviet Frontier

In the 1960s the IA PVO began introducing supersonic aerial intercept weapons systems. These comprised a radar-equipped all-weather interceptor with an IFF interrogator/transponder, air-to-air missiles and an automated GCI system. The first system of the kind was the T-3-51, which was built around the Su-9 *Fishpot-B* interceptor developed by Pavel O. Sukhoi's OKB-51 design bureau in the second half of the 1950s and officially included into the IA PVO inventory in October 1960.

A while later the IA PVO fielded the Su-11 *Fishpot-C* (forming the core of the Su-11-8M aerial intercept weapons system), the Yakovlev Yak-28P *Firebar* (which was never officially on the inventory, although more than 400 were delivered, serving with the PVO's fighter units for 25 years) and the Tupolev Tu-128 *Fiddler* heavy interceptor, which formed the core of the Tu-128S-4 aerial intercept weapons system. In late April 1965 the Su-15-98 aerial intercept weapons system built around the Su-15 *Flagon* officially joined the IA PVO inventory. These systems will be described in more detail later.

As had been the case in the 1950s, the Soviet Air Force (specifically, Tactical Aviation, or FA – *Fronto**va**ya aviah**t**siya*) fighters were frequently called upon to intercept intruders alongside IA PVO fighters in the 1960s and 1970s. These included such types as the MiG-21PF *Fishbed-D* and MiG-21PFM *Fishbed-F*, followed later by the MiG-21S and MiG-21SM (both known to NATO as *Fishbed-J*). In the 1980s a few Air Defence Aviation fighter regiments were equipped with a sub-variant of the MiG-21*bis* optimised for the PVO and featuring *Lazoor'* (Prussian Blue) GCI system equipment, known to NATO as the *Fishbed-L*.

After the reorganisation of the Air Defence Force in 1960, when the PVO armies and independent PVO corps were transformed into independent PVO armies, the fighter units were organised into PVO corps and divisions without corps-level and divisional headquarters. The PVO's fighter air armies were disbanded. The various air defence assets were placed under the direct control of the PVO formations' command posts. The separate command



Three Su-9s make a flypast during the 1967 parade at Moscow-Domodedovo.

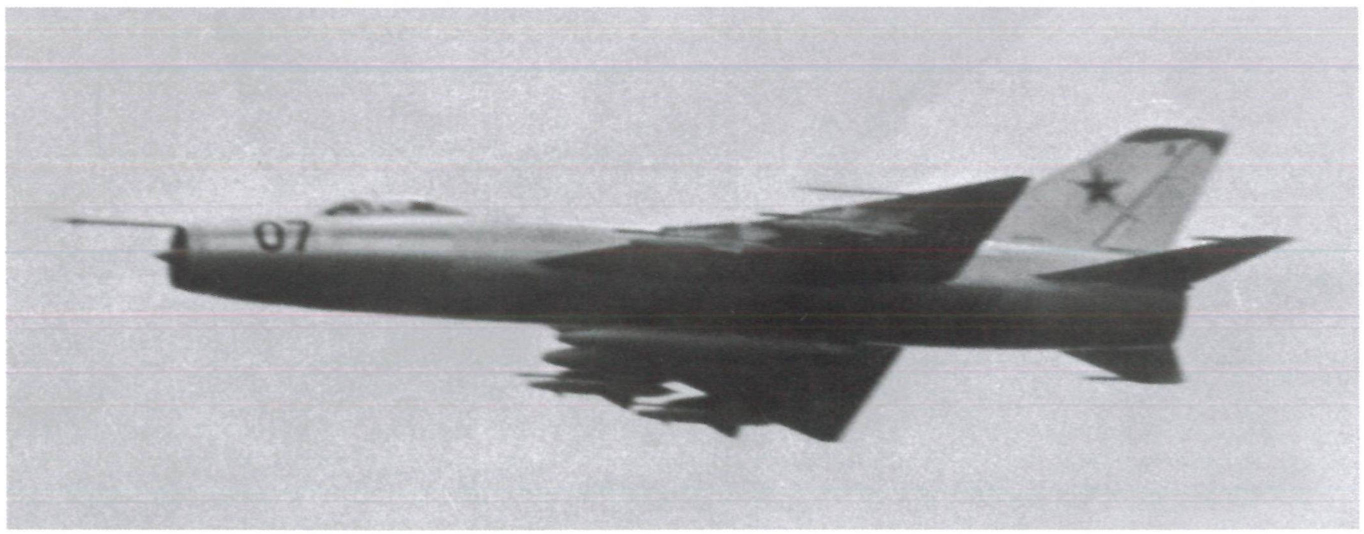
posts of the Air Defence Force's branches were abolished as well. Also, since the Air Defence Force now operated considerable numbers of utility aircraft performing support functions, the IA PVO was officially renamed the PVO Aviation, shedding its fighter-only image, and the post of IA PVO Commander was accordingly redesignated as the PVO Aviation Commander.

In 1961 the PVO Aviation Commander Col.-Gen. Yevgeniy Ya. Savitskiy was promoted to Air Marshal. He held this post until 1966 when he was superseded by Lt.-Gen. Anatoliy L. Kadomtsev. Tragically, the latter remained in office for only three years. On 26th April 1969 Kadomtsev made his first flight in the Ye-155P-11, one of the MiG-25P *Foxbat-A* prototypes – which was to be his last. Shortly after take-off from Akhtoobinsk the starboard R15B-300 engine tossed a turbine blade, rupturing a hydraulic line and causing a massive fire. On hearing the hydraulics failure/fire warning, Kadomtsev asked the tower for instructions and was ordered to eject. Just then, however, the control system failed altogether; the aircraft rolled uncontrollably and plunged into an arm of the Volga River, killing the pilot. It was never established with certainty why Kadomtsev did not eject. Perhaps he had operated the seat incorrectly, being used to Sukhoi aircraft with a different ejection algorithm (although NII VVS test pilot Stepan A. Mikoyan, the nephew of General Designer Artyom I. Mikoyan, wrote in his memoirs that Kadomtsev knew the ejection technique), or perhaps the ejection mechanism was also damaged somehow. When the cause of the accident was discovered, the Tumanskiy OKB redesigned the turbine of the R15B-300 and imposed a temporary limit on the turbine temperature.

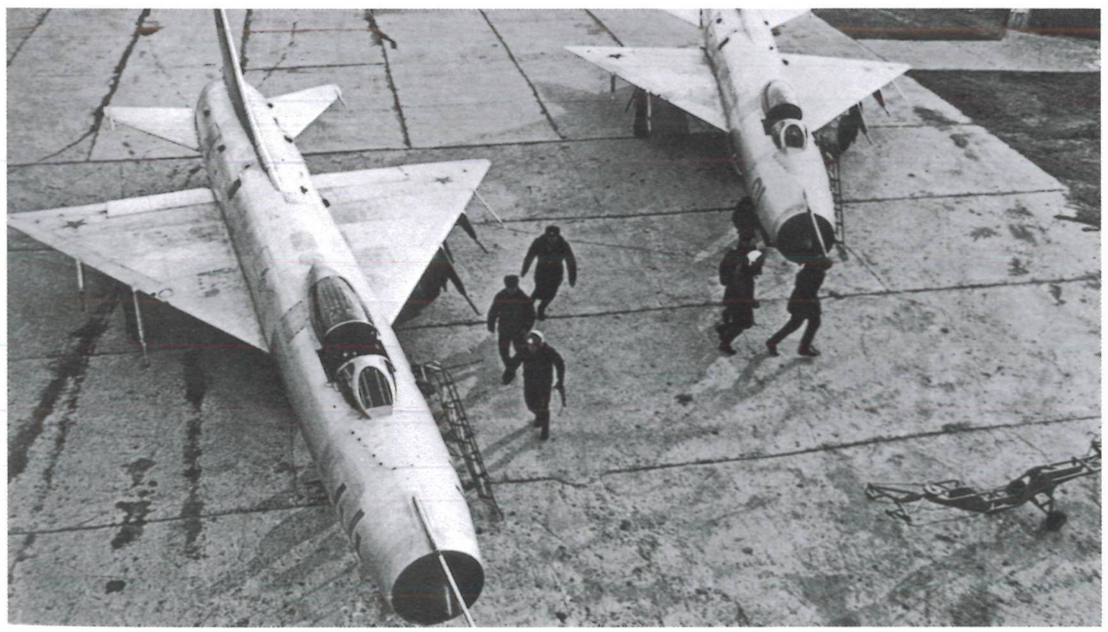
Kadomtsev's death, which caused quite a commotion, was a sore loss to the PVO, because he was a competent commander and looked certain to become the next Soviet Air Force C-in-C. It was also a severe blow for Artyom I. Mikoyan, who flew to Akhtoobinsk to participate in the investigation of the crash; he suffered a massive heart attack on returning to Moscow and passed away a year later, on 9th December 1970.

After Kadomtsev's death in harness, Col.-Gen. Andrey Ye. Borovykh was appointed the new Commander of the PVO Aviation. On 21st April 1977 he, in turn, was succeeded by Col.-Gen. Nikolay I. Moskvitelev.

Originally a naval pilot, Moskvitelev had been CO of the Black Sea Fleet air arm's 62nd IAP and had been transferred to the PVO together with the regiment in April 1960. After 17 years of sterling service in the national Air Defence Force he became Commander of the PVO Aviation. By no means a 'chairborne commander', Col.-Gen. Moskvitelev continued to master both operational fighter types and new ones as they came along; this allowed him to participate actively in the shaping of the PVO Aviation's tactics and combat training techniques. During his years as Commander the personnel of the PVO fighter units successfully learned the techniques of beyond visual range (BVR) engagement in the Tu-128M, MiG-25P/MiG-25PD and, later, MiG-31 long-range interceptors, as well as the Yak-28P low-altitude interceptor, the tactics of BVR combat

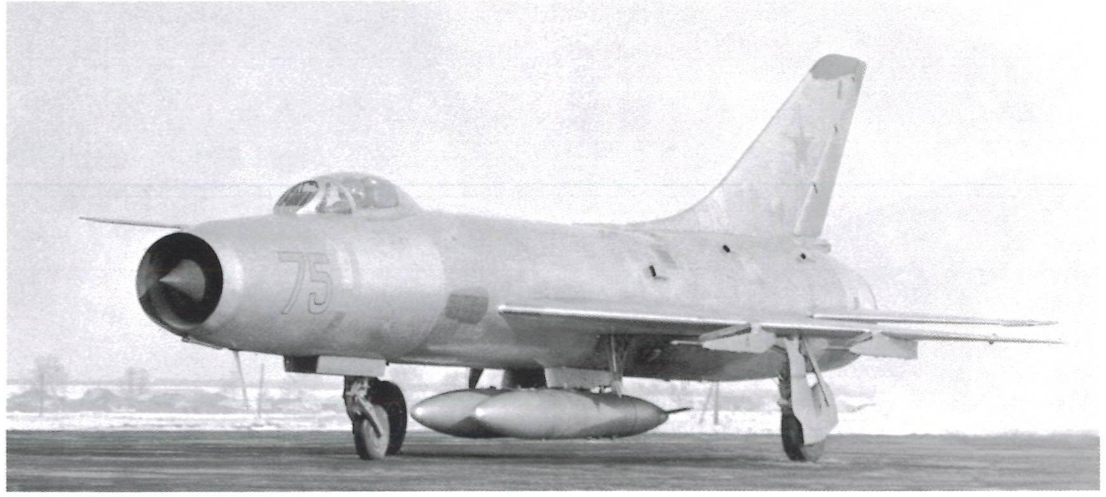


A publicity photo of a pair of Su-9s taking off.



Crews sprint to a pair of Su-9s during a practice scramble (note the absence of missiles on the wing pylons).

Opposite: A Su-9 carrying four RS-2-US missiles and two drop tanks.



'75 Blue', an early-production Su-9 (as revealed by the non-functional gun blast plates), taxies out for take-off.

and close-in dogfighting in the Su-15/Su-15T/Su-15TM, MiG-23P/MiG-23ML and Su-27P fighters. Nikolay I. Moskvitelev maintained a good working relationship with aircraft designers, notable scientists and other aviation specialists, co-operating with them to help refine the aircraft of the PVO, their control systems, life support systems and the like. The weapons systems fielded during the decade when Moskvitelev was Commander of the

A routine publicity shot from the flight line of a PVO unit operating Su-9s. Typically of PVO aircraft, the tactical codes are blue. Note that the missile pylon leading edges have black anti-glare strips. The pilots are wearing GSh-4MS pressure helmets.

Opposite: A late-production Su-9 with two drop tanks seen during final approach. It was standard operational procedure to deploy the flaps for landing only (they were left up for take-off).

PVO Aviation remained in service all the way until the demise of the Soviet Union, and some of them beyond that.

As mentioned earlier, the first new-generation aerial intercept weapons system fielded in the 1960s was the T-3-51 whose main components were the Su-9 delta-wing interceptor and the RS-2-US (NATO AA-2B *Alkali*) medium-range radar-homing AAM. The Su-9 entered service as early as June 1959, gradually replacing both the subsonic MiG-17PF/MiG-17PFU and the supersonic MiG-19PM (the former of these had cannons only, while the other two were armed with similar AAMs). Mastering the *Fishpot-B* proved to be quite a challenge for flight and ground crews alike, owing to the new technology which had gone into the design of the Sukhoi jet and the complexity of its equipment. On the one hand, the new interceptor had much higher speed and altitude performance than the predecessors; on the other hand, it still suffered from numerous teething troubles. As a result, the Su-9's accident rate at the service introduction stage was truly horrifying, which had a long-term negative effect on the type's service career.

The Su-9 achieved initial operational capability (IOC) with an IA PVO regiment stationed at Novosibirsk-Tolmachovo airport, a stone's throw away from aircraft factory No.153 located at Novosibirsk-Yel'tsovka. (In the Soviet Union, and in modern Russia, quite a few airfields, including Tolmachovo, served a dual purpose, being both civil airports and Air Force bases.) This was common practice when a new aircraft type was being fielded; the close proximity of the manufacturer allowed any problems to be rapidly resolved.

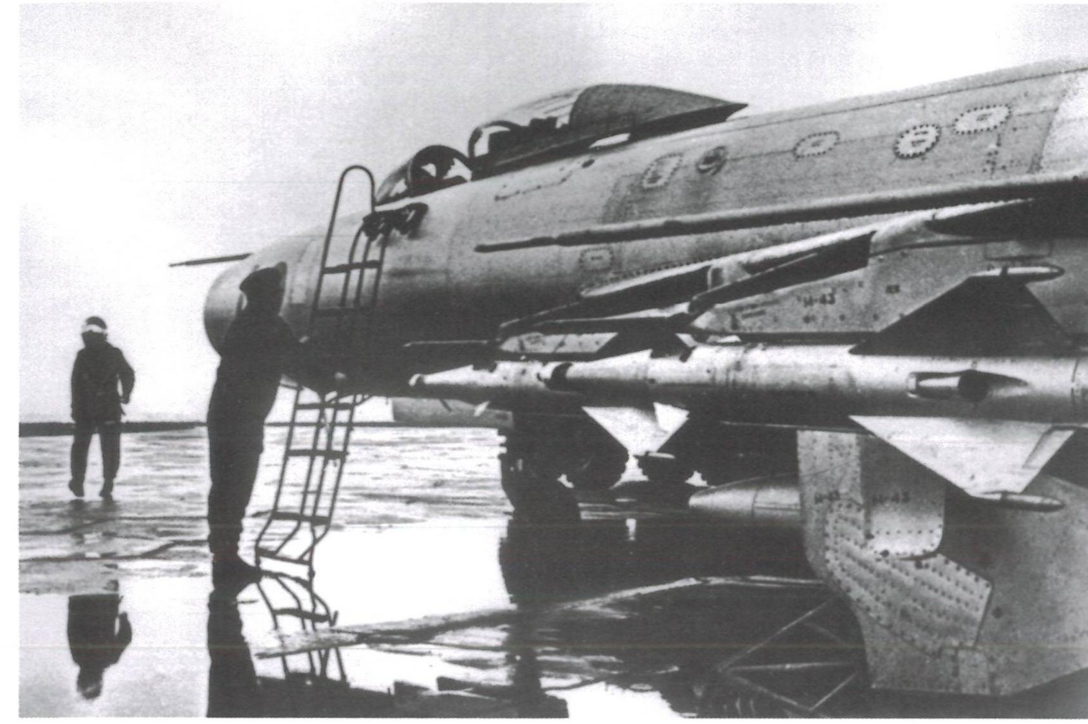
A Su-9 pilot wearing a life jacket and ZSh-3 'bone dome' helmet poses with his aircraft, which is armed with four RS-2-US missiles. The APU-19 and APU-20 launch rails have sharp tips, so the ground personnel have to be careful to avoid injury.

A Su-9 on QRA duty, with a full complement of missiles and drop tanks and the canopy open, ready for the pilot to climb in.

Concurrently the PVO's training centre at Savasleyka AB – by then known as the 148th TsBP i PLS (*Tsentr boye**voy** podgo**tov**ki i pere**oo**chivaniya **lyot**novo sos**tah**va* – Combat Training & Aircrew Conversion Centre) – dispatched a group of highly skilled pilots to the regiment to take conversion training *in situ*. (Normally such conversion training centres would be the first to receive the new hardware, but here the procedure was reversed because of the need to stay close to the factory.) IA PVO Commander Air Marshal Yevgeniy Ya. Savitskiy tasked the unit's personnel with mastering the type as quickly as possible and then assisting the deliveries of new Su-9s to other operational units. By early July the PVO pilots had made 72 flights in the first eight production fighters; six service pilots had received their type ratings, with another three in the training pipeline.

The PVO units stationed in Krasnovodsk (Turkmenia; later renamed Turkmenbashi), Baranovichi (Belorussia), Karshi (Uzbekistan) and at Kilp-Yavr AB (Murmansk Region, north-western Russia) converted to the Su-9 in short order. In a departure from normal practice the fighters were ferried from Novosibirsk, not delivered in crates by rail. Due to the Su-9's limited range this was no easy task, as it was necessary to stage through airfields located no more than 1,000 km (620 miles) apart – which was often impossible in Siberia and the Soviet Far East with their huge expanses of woodland. As a way out, the PVO top command proposed fitting the Su-9 with a special non-jettisonable large-capacity ferry tank supplanting the two standard drop tanks. In November 1959 Sukhoi OKB engineers proposed a conformal tank fitted to the existing fuselage hardpoints. Estimated range with this tank was almost twice the range possible in standard configuration. Ironically, however, it was the military who eventually killed off the idea by demanding that a fuel jettison or emer-

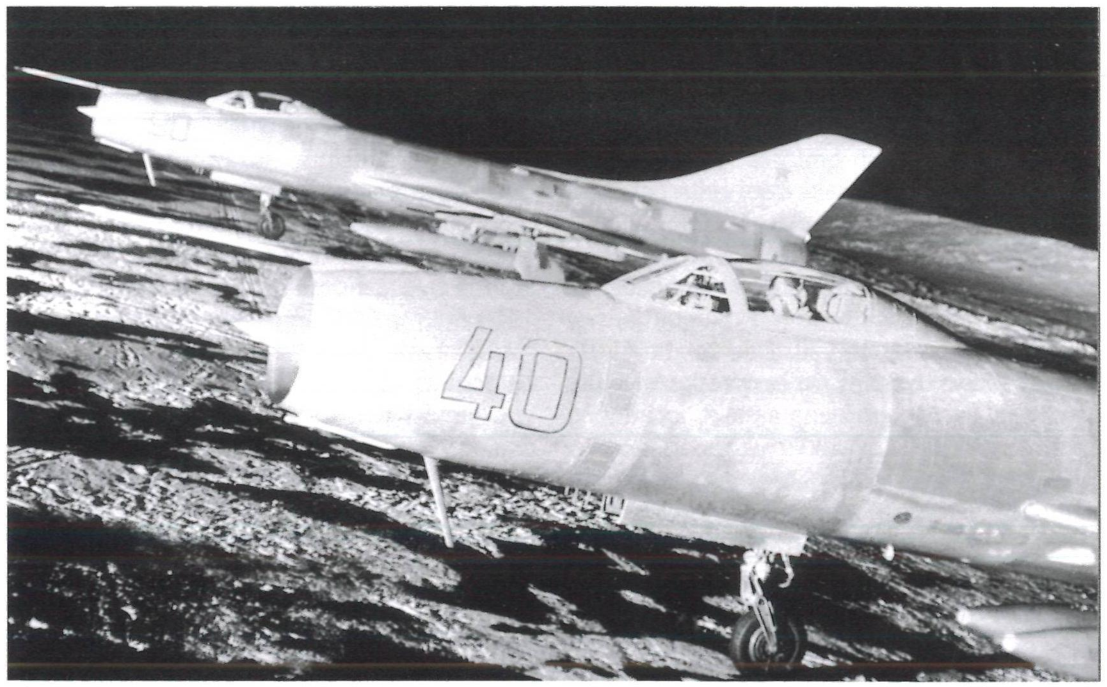
This early 1970s' publicity photo of early Su-9s is supposed to represent a scramble. However, aircraft on QRA duty would not normally have the cockpit and missiles under wraps!



A crew chief hooks up a boarding ladder to a late-production Novosibirsk-built Su-9 loaded with a full complement of four RS-2-US missiles and drop tanks.

Su-9 '27 Blue' with a rarely seen R-55 IR-homing AAM on the outer pylon. Note the partially open port upper air-brake.

Above and right: Su-9s '40 Blue' and '90 Blue' on a floodlit hardstand before a night practice sortie. Neither aircraft carries missiles.



One more view of the same Su-9 coded '40 Blue'. Two drop tanks are fitted.

gency tank jettison feature be incorporated – which turned out not to be feasible.

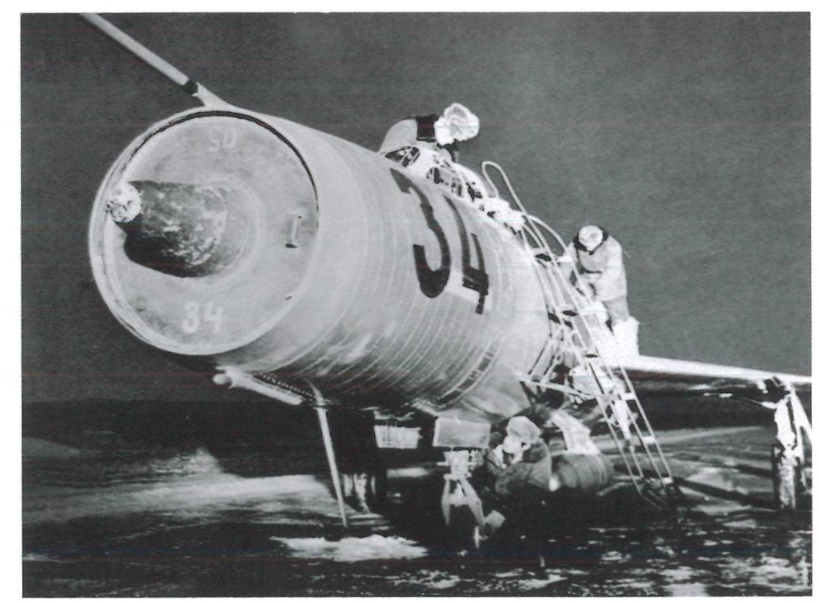
Intercepting a target at medium altitude presented no difficulties even for average-skilled pilots. An interesting 'pass me and die' tactic was developed against supersonic unmanned targets; the Su-9 would be directed to a point ahead of the target on its anticipated course, flying slightly below it, and then fire the missiles as the target overtook it. On the other hand, slow-flying high-altitude targets (such as the Lockheed U-2) were much harder to cope with. In order to reach the Su-9's service ceiling the pilot needed to execute the so-called basic mode – that is, climb to a certain altitude (not less than 10,000 m/ 32,800 ft), then accelerate to Mach 1.6 in level flight and gently put the aircraft into a climb while maintaining an indicated airspeed of 1,100 km/h (683 mph), the Mach number increasing to 1.9 in the process. After that, the aircraft would climb at high angles of attack; the speed needed to be at least Mach 1.7, otherwise the Su-9 would simply stall at that altitude. Concurrently the pilot had to make constant course corrections as instructed from the ground in order to get a target lock-on – and, since the interceptor was closing in on the target all too fast, the pilot had very little time for making an attack.

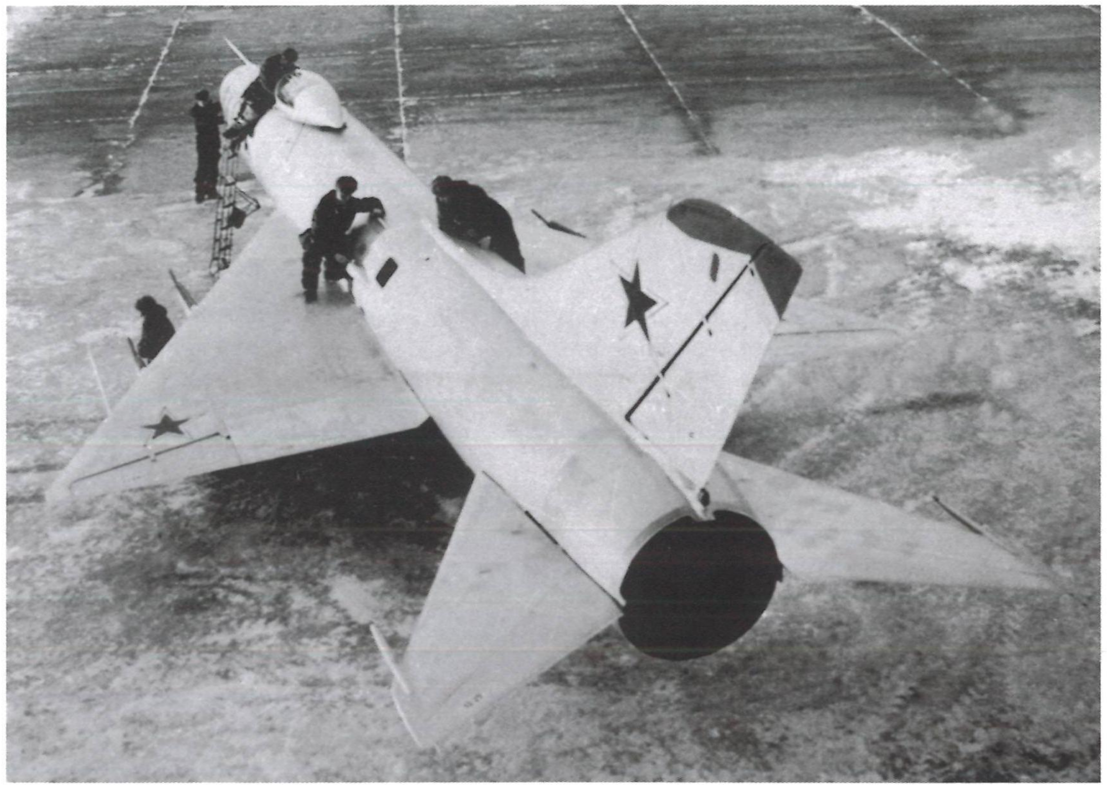
Slow-flying Yakovlev Yak-25RV *Mandrake* high-altitude reconnaissance aircraft were used as practice targets for simulated attacks, as were Tupolev Tu-16 medium bombers and other Su-9s. During live weapons training at target ranges the Su-9s fired at Il'yushin IL-28M, Mikoyan/Gurevich M-15 and M-17 target aircraft (converted time-expired IL-28 tactical bombers and MiG-15/MiG-17 fighters respectively) and purpose-built Lavochkin La-17 jet-powered target drones.

Initially, Su-9 conversion training was complicated by the lack of a dedicated trainer version. Future Su-9 pilots first made several flights in the subsonic UTI-MiG-15 *Midget* trainer; then, having got a credit in the theoretical training course, they started mastering the practice part on the single-seat Su-9. This situation persisted until 1962 when MMZ No.30 *'Znamya Trooda'* (*Moskovskiy mashinostroitel'nyy zavod* – Moscow Machinery Plant No.30 'Banner of Labour'), the other production plant building the type, launched production of the dual-control Su-9U *Maiden*. Several of these aircraft were delivered to the 148th TsBP i PLS; the first-line units equipped with the Su-9 also took

An unusual 'toad's eye view' of a Su-9. Note the open airbrake.

Maintenance work on a Su-9 in the middle of the night. Judging by the intake cover, '34 Blue' was previously coded '05'.

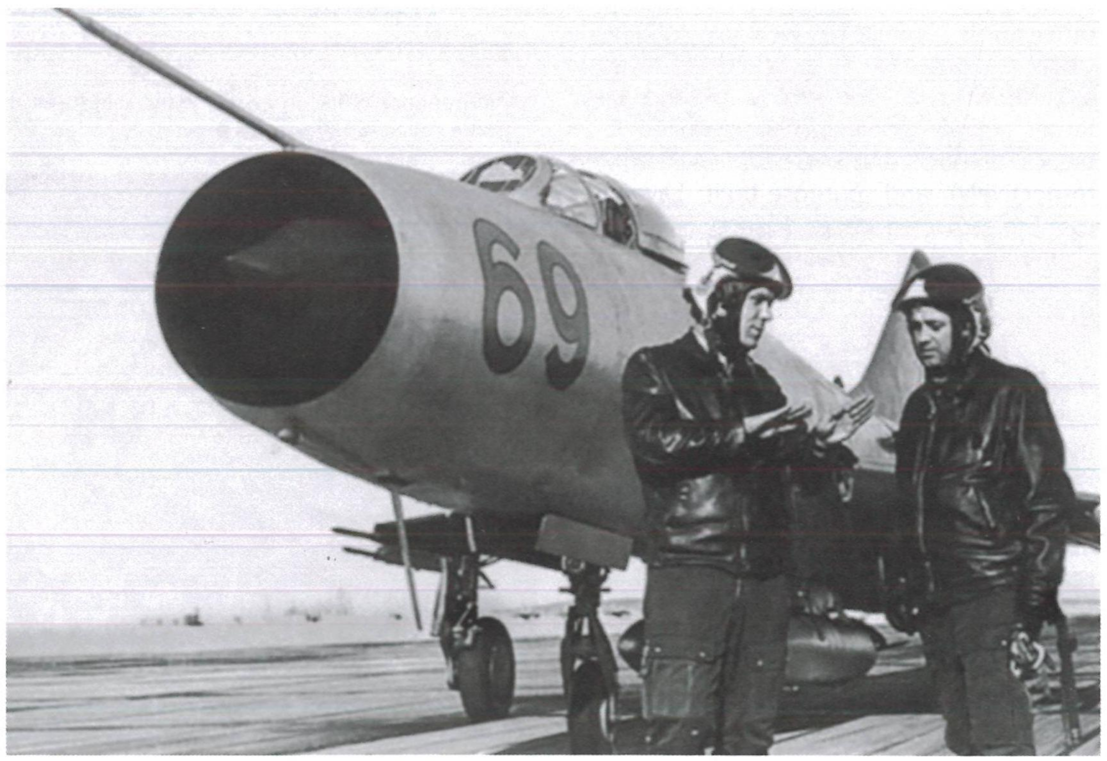




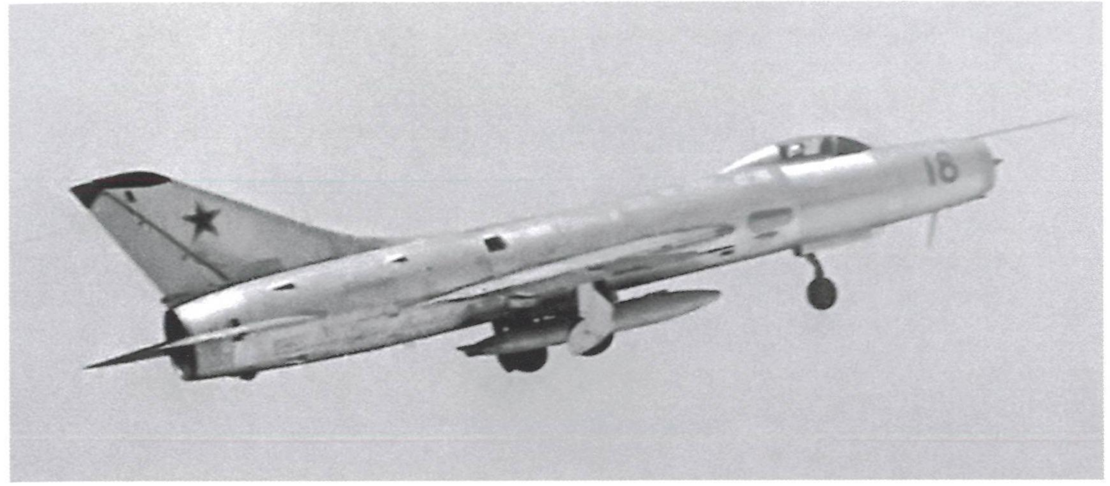
Technicians swarm like ants over a Su-9 undergoing maintenance. The black hole is an air spill grille immediately ahead of the engine.

delivery of one trainer each. Even so, the UTI-MiG-15 (supplanted in the second half of the 1960s by the Su-7U *Moujik*) was still used for Su-9 pilot lead-in training because the Su-9Us were in short supply.

The first months of operational service revealed a host of problems. For one thing, the Su-9's Lyul'ka AL-7F-1 engine had an appallingly low time between overhauls (a mere 25 to 50 hours) in the early days, which meant that the interceptors were often grounded by lack of engines. For another, systems and equipment often failed both in flight and during ground checks, and many equipment items were not easily accessible, requiring the aircraft to be substantially 'undressed'.



Two 849th IAP pilots wearing leather jackets and 'bone dome' helmets with tinted visors discuss intercept techniques in front of a Su-9 at Koopino AB near Novosibirsk.



A Su-9 coded '18 Blue' begins its landing gear retraction sequence.

'06 Blue', another Su-9 pictured on take-off. Note that the flaps are retracted.

'29', an early Moscow-built Su-9, serving as an instructional airframe at a PVO Junior Technical Specialists' School.

An atmospheric dusk shot of Su-9 '15 Red' on a flight line with 'streetlights'. Note the signal lamps telling ground observers that the landing gear is down and locked.

A pair of blue-coded Su-9s awaiting a sortie on a winter night.

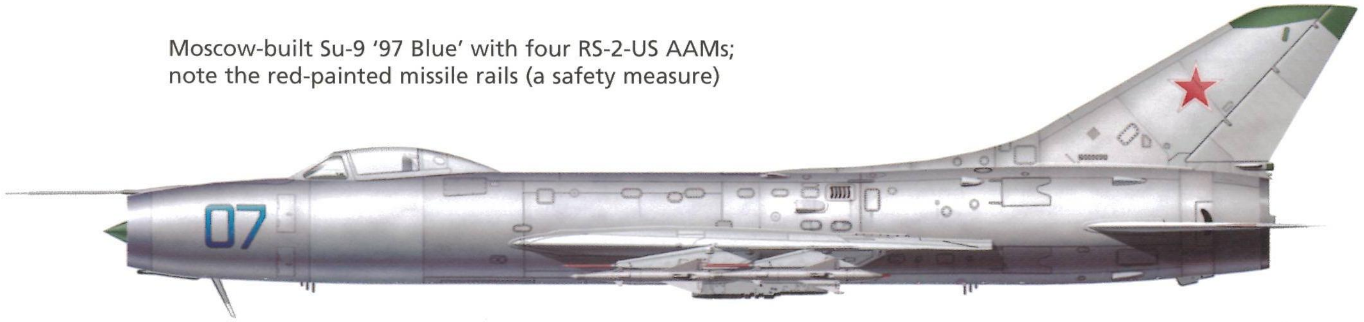
An incessant stream of claims kept pouring in at the factory and the OKB; the latter took corrective measures, and at times the factory was swamped in bulletins requiring this or that modification to be made. This unfortunate situation was eventually resolved, the manufacturer sending teams to perform the necessary modifications *in situ*. One of the first important upgrades was the introduction of the ESUV-1 electrohydraulic system controlling the air intake shock cone and auxiliary blow-in doors. In the course of 1960 Sukhoi OKB and Novosibirsk aircraft factory teams had modified more than 120 Su-9s in service.

On the other hand, jet fuel was abundant in those days, and in the days of the Su-9's service introduction period the PVO pilots often logged as many as 150-200 flying hours per year. The service pilots were happy with the fighter's performance and handling; the Su-9 had next to no unpleasant peculiarities in transonic flight mode. True enough, the Su-9's outstanding acceleration created a few problems in the early days; pilots recalled that the aircraft accelerated very quickly to its maximum landing gear transition speed during take-off and you had to be quick in 'cleaning

A still from a movie showing a Su-9 in action. The RS-2-US missiles were fired in pairs.

Su-9s '40 Blue' and '90 Blue' about to taxi out.

Moscow-built Su-9 '97 Blue' with four RS-2-US AAMs; note the red-painted missile rails (a safety measure)

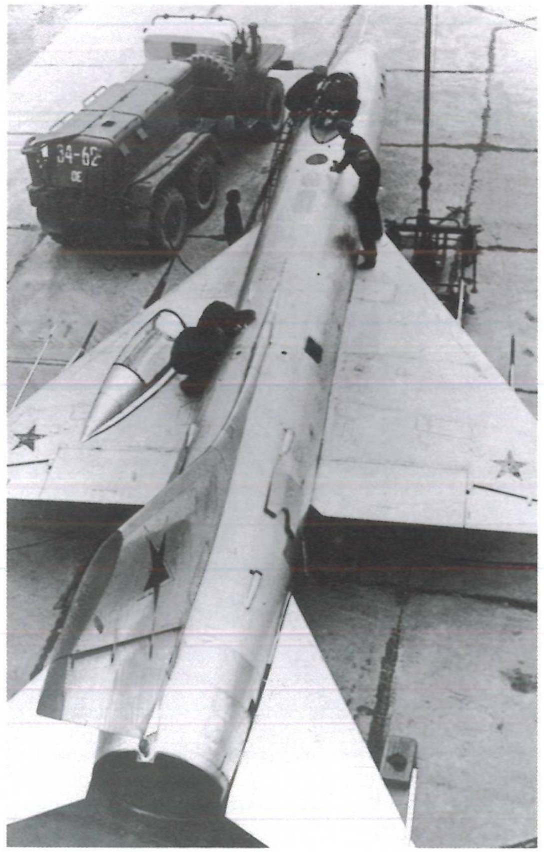


up'. Other peculiarities which took some adjusting to included an unusually high angle of attack during climb and landing approach, rapid deceleration from high speeds when the engine was throttled back, and the high landing speed.

By the mid-1960s nearly 30 PVO fighter regiments had re-equipped with the Su-9. For instance, in the Moscow PVO District the type was flown by the 28th IAP (Krichev AB), the 415th IAP (Yaroslavl'-Toonoshna airport) and the 23rd IAP based in Rzhev; in the 8th PVO Army (the Ukraine) the Su-9 saw service with the 90th IAP at Chervonoglinskaya AB, the 179th IAP at Stryy AB, the 894th IAP at Ozyornoye AB near Zhitomir and the 136th IAP at Kirovskoye AB on the Crimea Peninsula. The 2nd PVO Army based mostly in Belorussia included the 61st IAP in Baranovichi and the 201st IAP at Machoolishchi AB just outside Minsk flying Su-9s. As the ***Voz**dukh-1* (Air-1) GCI system found its way to PVO command centres, the Su-9 units began mastering the ground controlled intercept technique; the pilot would fly the aircraft in flight director mode, continuously making course corrections calculated by the command centre and relayed to the aircraft via the Lazoor' data link system. The aircraft thus followed the optimum trajectory towards the target, which considerably increased 'kill' probability.

The badge that went with the Sniper Pilot skill grade.

Technicians prepare to remove the ejection seat from a Su-9 by means of a jib. Note the partially open airbrakes. An APA-5 GPU based on the Ural-375D 6x6 army lorry provides electric power; unusually, this one has a cab with a collapsible canvas top, a rare version.



The Su-9's more advanced derivative, the Su-11, offered a more capable RP-11 ***Oryol*** (Eagle) radar and R-8M missiles. The Su-11-8M weapons system was officially included into the PVO inventory on 5th February 1962. The first unit to operate the *Fishpot-C* was the 393rd GvIAP at Privolzhskiy AB near Astrakhan', which began re-equipping from the Su-9 in the summer of 1964. The transition to the more advanced interceptor went fairly smoothly, and after this regiment had completed Stage A of the service trials, the entire production run of the Su-11 was delivered to first-line units in the first half of 1965. Apart from the 393rd GvIAP, these were two Moscow PVO District units – the 790th IAP at Khotilovo AB and the 191st IAP in Yefremov.

Compared to the predecessor, the Su-11 was much more 'user-friendly' and safer to operate; the aircraft as a whole and the engine in particular were much more reliable, and there were extremely few accidents caused by hardware failures. Another advantage over the Su-9 was the greater maximum interception altitude thanks to the more pow-

Novosibirsk-built Su-9 '10 Red' carrying two AAMs

Novosibirsk-built Su-9 '70 Red' with a full warload of four AAMs and two drop tanks

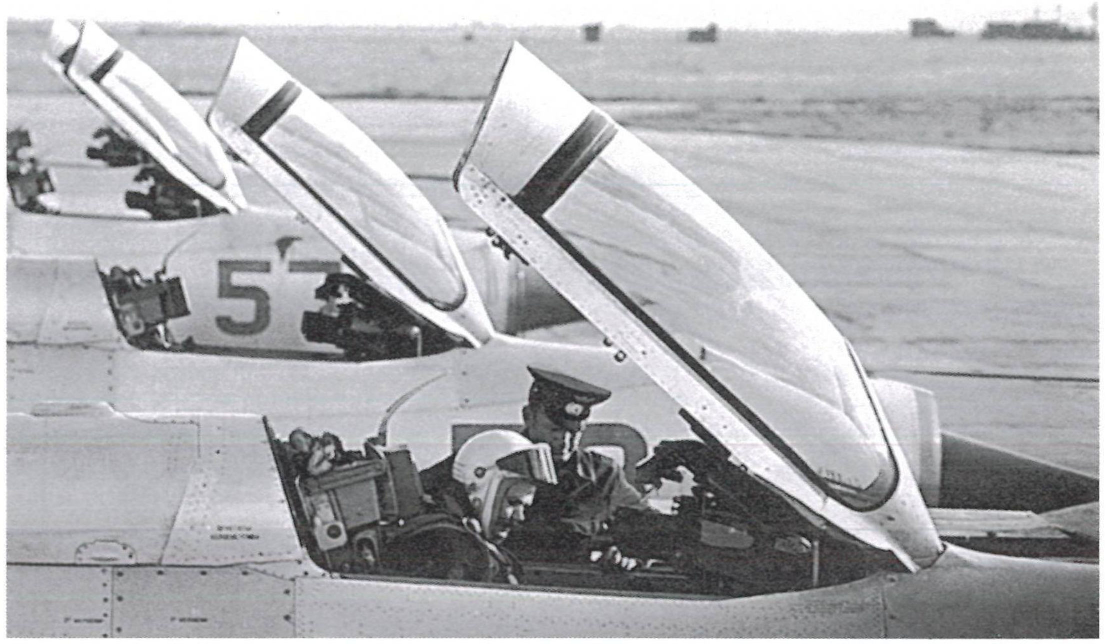
Novosibirsk-built Su-9 '74 Red' with drop tanks but no missiles; note the variance in tactical code styles

erful radar and the better missiles; these allowed the Su-11 to attack targets flying far above its own flight level and even gave it a measure of 'look-down/shoot-down' capability. Interestingly, the operational tactics developed for the Su-11 included even attacks against ground targets and surface ships. In reality, however, this was never done; the idea was not pursued further than a single experiment with firing RS-2-US AAMs at ground targets from a Su-9 in 1966. Apart from GK NII VVS test pilots, this programme involved service pilots, including some from the 350th IAP at Belaya AB.

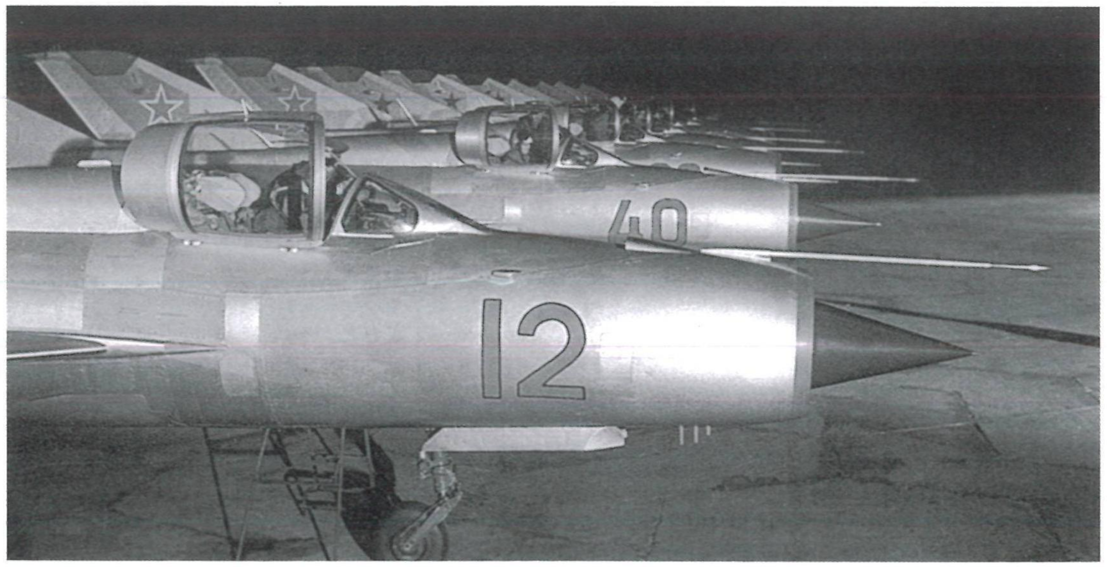
Taking account of the experience gained in the Vietnam War and the Arab-Israeli wars, the Soviet PVO command gave due attention to close-in dogfight tactics – even though the Su-9 and Su-11 were ill-suited for this kind of combat. Some units (for example, the 136th IAP at Kirovskoye AB) even staged group dogfights. Deployments to FOLs were also practiced; for example, in March 1966 a group of twenty 14th PVO Army Su-9s deployed to an *ad hoc* ice airfield in Tiksi, Yakutia, the ground personnel and ordnance being delivered there by Antonov An-8 *Camp* transports. In the 1970s the 8th PVO Army practiced Su-9 operations from short tactical strips.

In the 1970s the Su-9 was gradually phased out, yielding its place to the MiG-25P (and later the MiG-25PD/PDS) and the Su-15. As the units re-equipped with the new types, the 'unwanted' Su-9s were transferred to

An enamel badge marking the 30th anniversary of the 849th IAP (the number is not shown, as it was classified). It shows a Su-9 intercepting an intruder superimposed on the Soviet Air Force's 'sunburst' flag.



A MiG-21PF pilot receives last-minute instructions before a sortie. Three more *Fishbed-Ds* are standing at the ready with canopies open.



Though primarily an Air Force type, the MiG-21PFM was also used for national air defence tasks. These views show the *Fishbed-F*'s redesigned canopy. The pilots are wearing VK-3 flight suits and ZSh-5 protective helmets. Truck-mounted searchlights were often used to illuminate the flight line or runway at night.

Afterburners blazing, MiG-21PFMs '66 Blue' and '67 Blue' are about to depart on a night practice sortie (note that the missile pylons are empty).

other units. From 1976 onwards the Su-9s were progressively retired as time-expired; units operating the type re-equipped with the MiG-23M (followed by the MiG-23ML and the ultimate MiG-23P tailored to the PVO's needs). The surviving Su-9s and Su-11 were relegated to the storage depots in Rzhev and Kuibyshev, where most of them succumbed to the elements. A few were converted into target drones; others survived as ground instructional airframes.

Even though the PVO Aviation was fielding new missile-armed interceptors in the 1960s, older types armed with cannons only still served on in considerable numbers. The 472nd IAP at Kursk-Vostochnyy (Khalino) airport was a case in point. This unit had been one of the first operators of the MiG-19SV – a special

MiG-21PFM pilots wearing pressure suits and GSh-6 full-face pressure helmets.

A MiG-21PFM pilot in winter attire beside his fighter sporting an 'Excellent aircraft' badge.

high-altitude version of the MiG-19S day fighter tailored for the PVO; the unit's Squadron 1 began conversion training for the type in 1957. The unit maintained a constant duty, protecting the southern approaches to Moscow. By the early 1960s the 472nd IAP had gained a reputation as an accident-free unit thanks to the excellent work of its tech staff maintaining the fighters.

In 1967 the 472nd IAP participated in Exercise *Dnepr* (named after a river that flows across Russia, Belorussia and the Ukraine). While other PVO units converted to the state-of-the-art MiG-21, Su-9 and Su-11, the 472nd IAP stuck to *Farmers*, even though the unit's original aircraft had been sold abroad and replaced with newer ones. Squadrons 1 and 2 flew the MiG-19PM while Squadron 3 manned by young pilots still flew the even older MiG-17F. It was not until 1979 that the 472nd IAP started converting to the MiG-23P, becoming the last Soviet unit to fly the MiG-19.

As mentioned above, though operated by the Air Force (Tactical Aviation), not the Air Defence Force, the MiG-21PF and MiG-21PFM interceptors were also used for defending the nation's borders if no PVO units were stationed in the area. While being inferior to the Su-9 in altitude performance and range, the MiG-21PF/PFM made up for this by being more agile and better suited for dogfighting. Its sustained turn radius and time were, respectively, far tighter and shorter; the same was true for vertical manoeuvres. The MiG-21's Tumanskiy R11F2-300 engine was easier to operate because it had fewer anti-surge controls and no limitation as to how many times the afterburner could be engaged. In the mid-1960s the MiG-21PFM was superseded by the MiG-21S and subsequently the MiG-21SM; the former version was armed solely with missiles while the 'SM also featured a built-in cannon.

In 1965-68 a number of PVO Aviation regiments re-equipped with the new Su-15 and Yak-28P twin-turbojet interceptors. While the *Flagon* (see below) was able to intercept targets flying within a wide range of speeds and altitudes, the *Firebar* was primarily used against low-flying intruders trying to get below the PVO's radar cover.

Since 1967 the PVO's fighter units maintained 24-hour quick-reaction alert (QRA) duty in the northern regions of the Soviet Union. To this end a squadron of Yak-28Ps redeployed to Komsomol'skoye AB in the Khanty-Mansi Autonomous District of the Tyumen' Region (the base is now called Yugorsk-2, as the

Soviet pilots sprint towards a MiG-21PFS ('69 Red') and a MiG-21PFM.

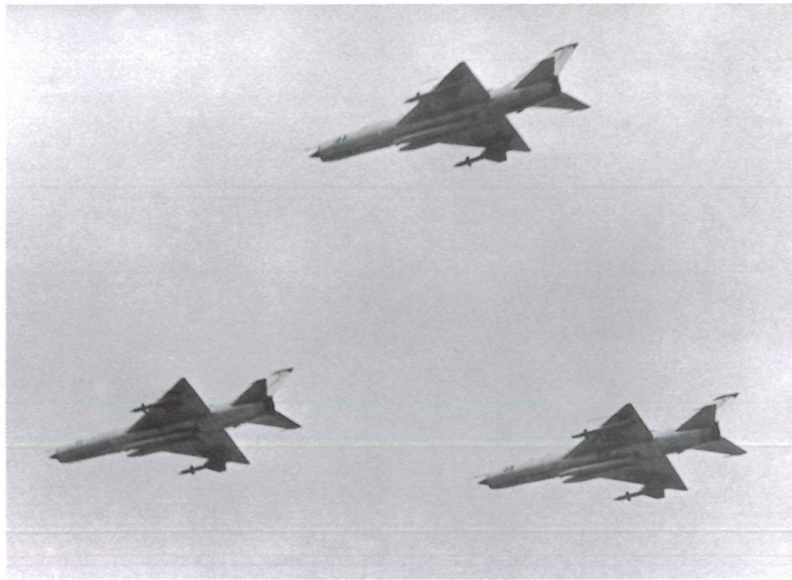
A pilot wearing a life jacket and a GSh-6 pressure helmet boards his MiG-21PFS coded '61 Red'.

A MiG-21SM with a PTB-800 drop tank

nearby town was renamed Yugorsk in 1992). Also, two additional AD radar sites were set up in Inta (a city in the Komi Autonomous SSR) and Beryozovo (a township and administrative centre in the Khanty-Mansi AD) to cover the northern sector.

Deliveries of the Yak-28P began in early November 1963. The 356th IAP (part of the

A flight of MiG-21*bis* fighters in air superiority grey finish.



14th PVO Army) stationed at Semipalatinsk, Kazakhstan, and guarding the co-located nuclear test range was the first to receive the new interceptor. By then one of the unit's squadrons had completed the theory course at the 148th TsBP i PLS. The Centre also trained the PVO's first qualified flying instructors (QFIs) to have the Yak-28P type rating; curiously, these flew only Yak-28U *Maestro* trainers because the 148th TsBP i PLS had no Yak-28Ps at the time.

By December 1963 two Yak-28Us had arrived in Semipalatinsk and conversion training began *in situ*. In January 1964 the 356th IAP commenced service trials of the new interceptor. IA PVO Senior Inspector Pilot Col. Selivanov and Lt.-Col. Kalashnikov, Deputy CO of one of the 148th Centre's constituent

A trio of Su-11s carrying missiles and drop tanks makes an airshow performance.

Two views of Su-11s at a PVO Junior Technical Specialists' School.

Su-11 '10 Blue' with drop tanks

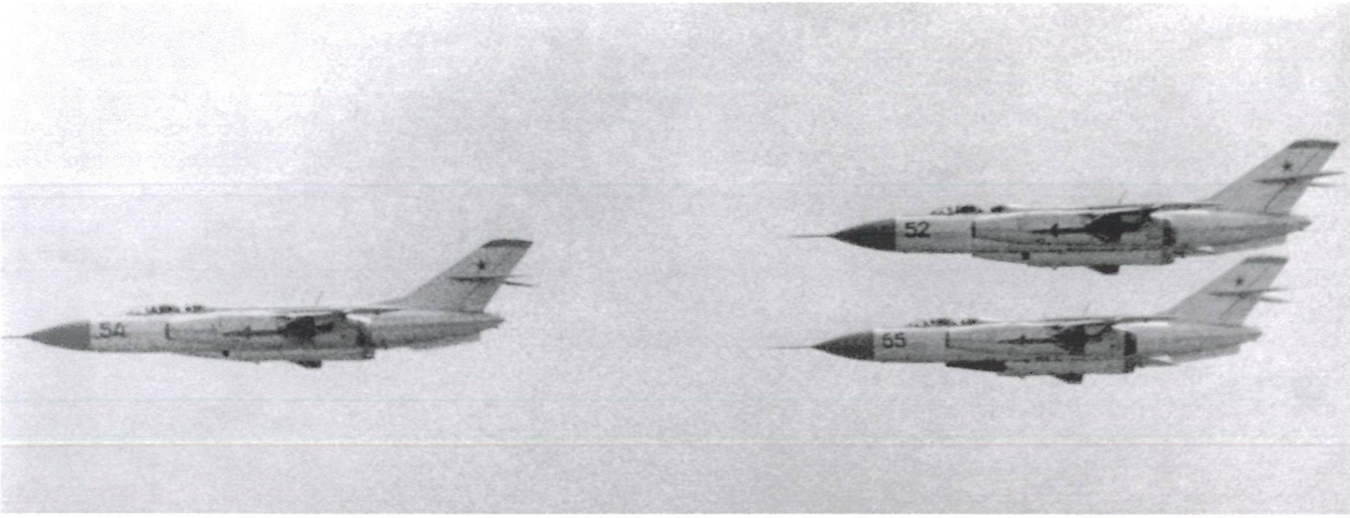
Su-11 '69 Blue' with drop tanks

fighter regiments, took part in these trials. One day in February 1964 Kalashnikov took off with weapons systems officer (WSO) Lt. (SG) Loosnikov to investigate the Yak-28P's high-speed stability and handling with a single missile. After passing Mach 1 the pilot reported that the fighter was banking in the direction of the missile; at Mach 1.5 he radioed that he had used one-third of the stick travel to maintain a wings-level attitude. After that, radio contact was lost. Later, when the crash site had been found, the investigators established that the aircraft had been overstressed and had broken up in mid-air, killing the crew.

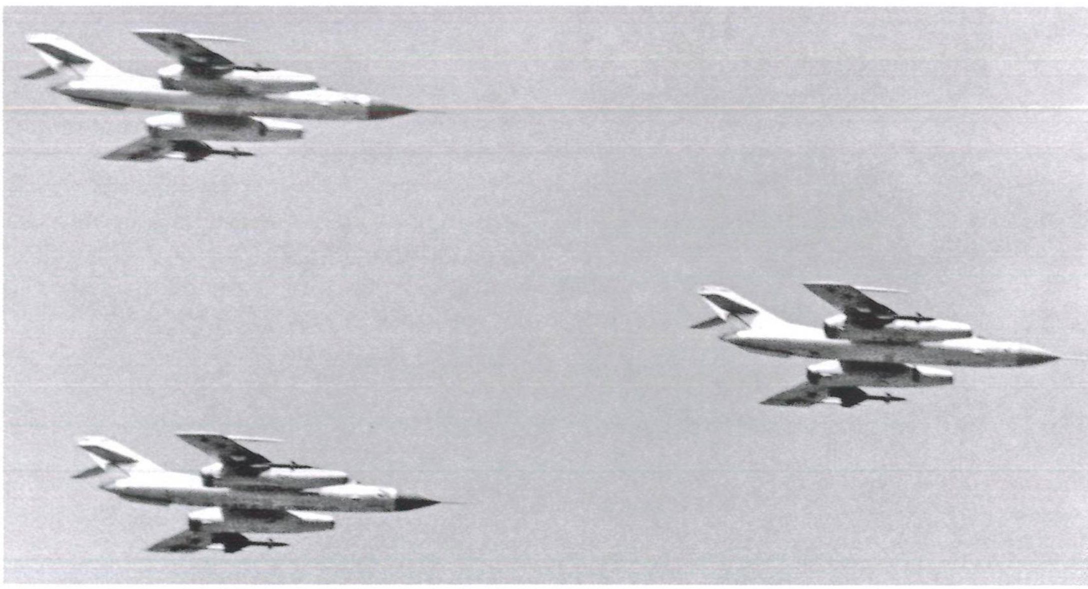
Despite this tragic accident, the Yak-28P attained IOC fairly quickly. By the end of the year one squadron of the 356th IAP had completed the transition; the other two squadrons stuck to the Su-9. In order to change the service pilots' wary attitude towards the new interceptor a group of test pilots came to Semipalatinsk in May 1964 to give a demonstration of the *Firebar*'s capabilities. The show included an impressive aerobatics display – loops, barrel rolls, yo-yos and so on. (However, this did *not* mean service pilots could do the same; in fact, any kind of vigorous manoeuvres on the Yak-28P was strictly prohibited throughout the type's service career!)

Also in 1964, the 10th PVO Army's 174th GvIAP based at Monchegorsk near Arkhangel'sk re-equipped completely with the *Firebar*, relinquishing its Yak-25Ms and MiG-19P/PMs. As production continued the Yak-28P equipped a further three 10th PVO Army units – the 641st GvIAP at Rogachovo

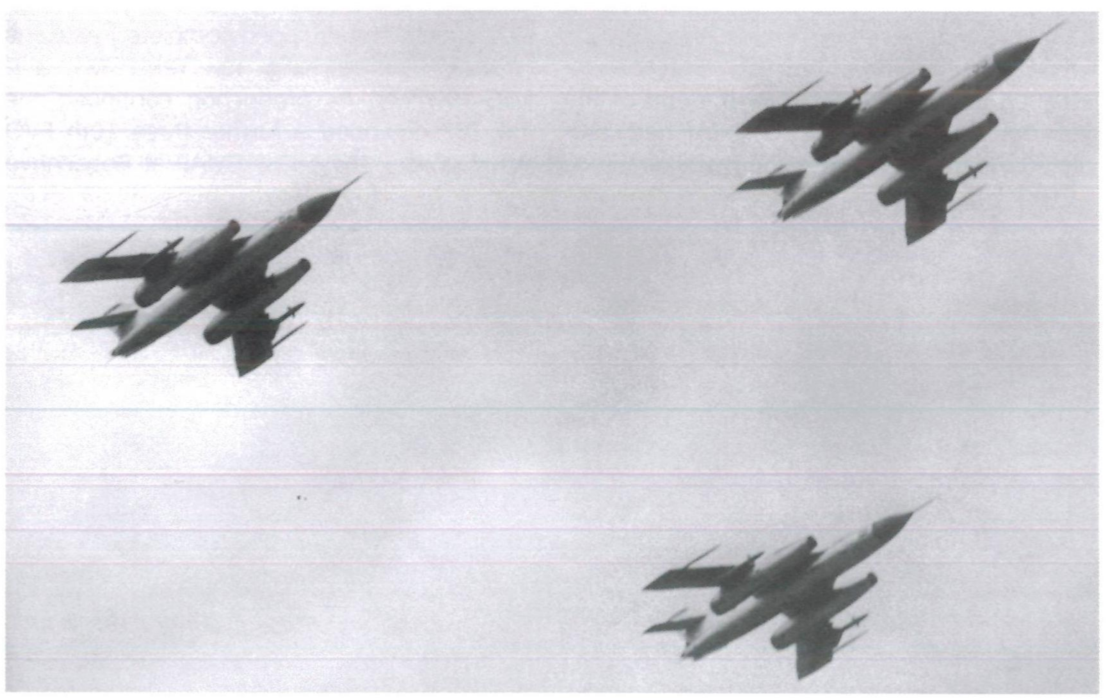
An operational Su-11 coded '68' uses its brake parachute and air-brakes to shorten the landing run. The brake parachute was not always deployed because collecting and repacking it afterwards was additional work for the ground crews.

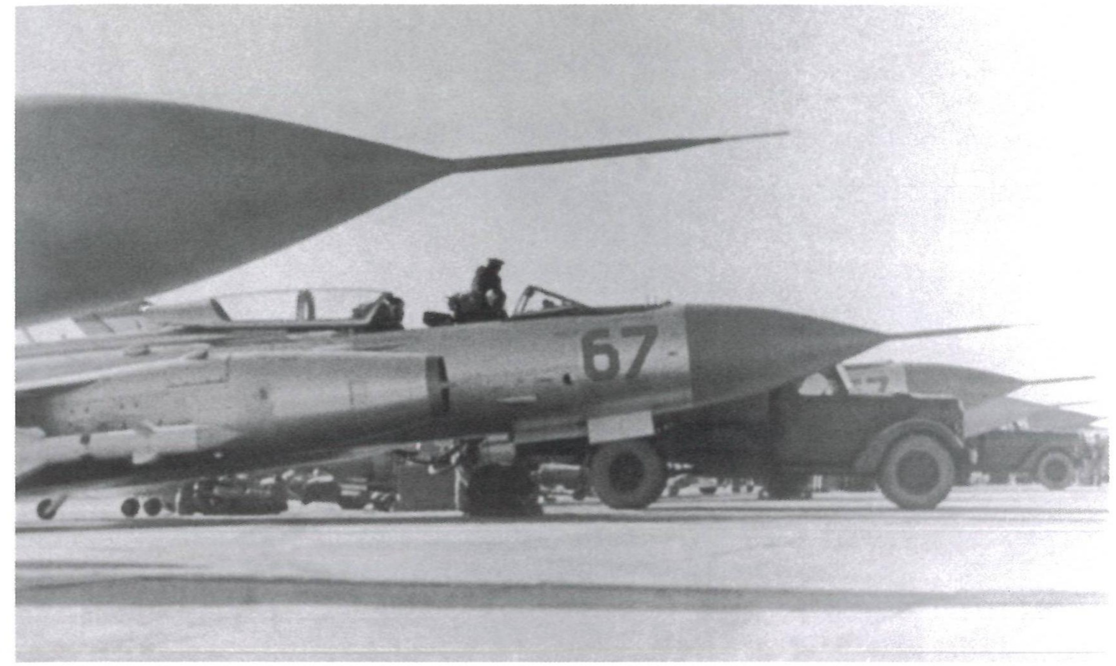


A trio of Yak-28Ps at the Moscow-Domodedovo airshow on 9th July 1967. The R-8M AAMs are painted red for greater conspicuity.



One more Vee formation of three Yak-28Ps (the early version with the short ogival radome).





Yak-28Ps armed with R-8Ms on the flight line, with attending APA-2M GPUs based on the ZiS-150 lorry.

AB on Novaya Zemlya ('New Land') Island in the Kara Sea, the fighter regiment in Letneozyorsk and the independent composite fighter squadron at Bezrechnaya AB which also operated the elderly MiG-17PFU *Fresco-E*. In the Leningrad PVO Army the type served with the 372nd IAP in Daugavpils (Latvia) and the 655th IAP in Pärnu (Estonia). In the 8th PVO Army it was operated by the 738th IAP in Zaporozhye (the Ukraine), in the 4th PVO Army by the 763rd IAP at Komsomol'skoye AB, in the Baku PVO District by the 50th IAP at Nasosnaya AB near Baku, the 171st IAP in Gudauta and the 562nd IAP at *stanitsa* (Cossack village) Krymskaya (now the city of Krymsk). Lastly, the 11 PVO Army in the Far East had Yak-28P units stationed at Smirnykh AB (Sakhalin Island, 528th IAP) and Petropavlovsk-Kamchatskiy/Yelizovo airport (the Kamchatka Peninsula, 865th GvIAP).

A Yak-28P at a dispersal in a winter setting. No missiles are fitted. Note the black anti-glare panels on the engine nacelles.

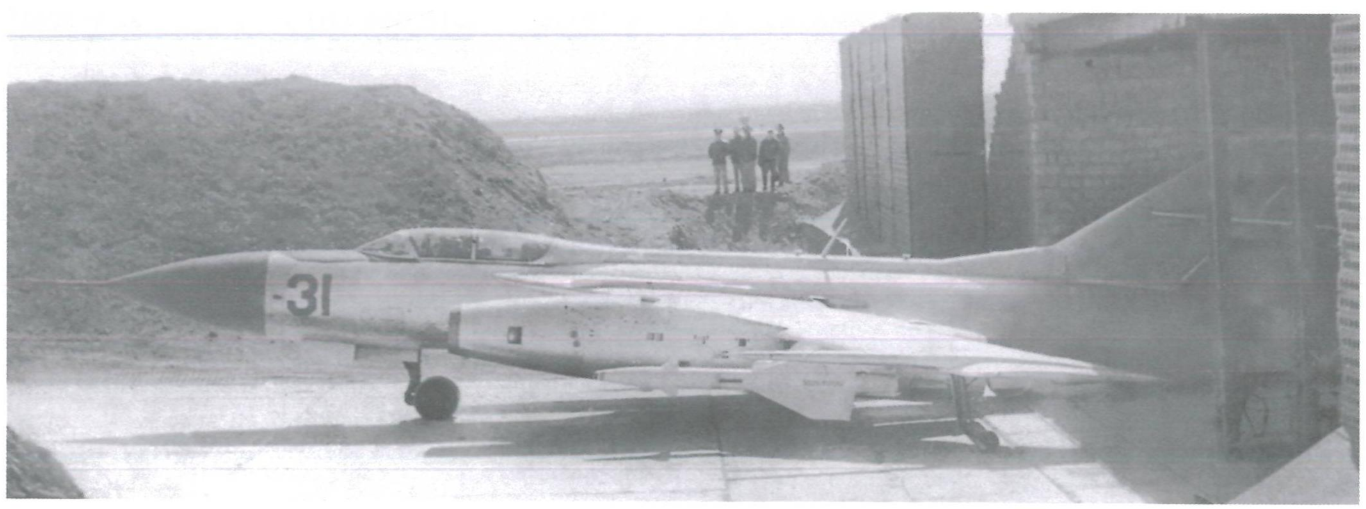
The crew of a 655th IAP Yak-28P before flying a sortie from Pärnu. Note the spring-loaded anti-surge blow-in door.

The units flying the Yak-28P were tasked with the PVO's usual mission – protecting the borders and point defence of strategic targets (major industrial centres, sensitive military installations and, of course, the capitals of the Soviet Union and its constituent republics). Additionally, in littoral regions the PVO units provided air cover for the Navy. Normally each regiment had two aircraft on QRA duty; in areas where incursions were particularly probable this number was doubled.

Yak-28P crews trained a lot, averaging 100 flight hours a year. In the early years of the type's career about one-third of the training sorties involved supersonic flying. As the individual aircraft accumulated flying hours, however, flights above Mach 1 grew increasingly less frequent, dwindling to almost nothing by the early 1980s. Apart from flying skills, much attention was paid to training the crews in target interception techniques, in particular against low-flying targets. The latter was quite a challenge, since the *Firebar's* Oryol-D radar did not give it 'look-down/shoot-down' capability and the aircraft often had to descend below 100 m (330 ft) in order to spot a low-flying target. Here the Yak-28P had a major advantage over the Su-15 *sans suffixe* equipped with the same radar; being a two-seater, the *Firebar* had a much lower crew workload, which was important during low-level missions imposing a lot of stress on the pilot. In contrast, the pilot of the *Flagon-A* found it virtually impossible to fly the aircraft and work the radar at the same time.

Until the late 1960s Yak-28P crews usually undertook live weapons training at the PVO's Krasnovodsk Combat Training Centre in Turkmenia which had a target range of its own near Kara-Bogaz-Gol Bight in the Sea of Azov. Each year the individual squadrons of every Yak-28P unit took turns deploying to Krasnovodsk where they practiced for eight to ten days, shooting at M-17, M-28 and La-17MM target drones and PM-1 parachute-retarded targets. In the 1970s, however, virtually each PVO Army had its own training range and this practice was abandoned.

An 82nd GvIAP Yak-28P parked outside its hardened aircraft shelter (HAS) at Nasosnaya AB near Baku in the late 1960s. Note the thickness of the shelter doors.



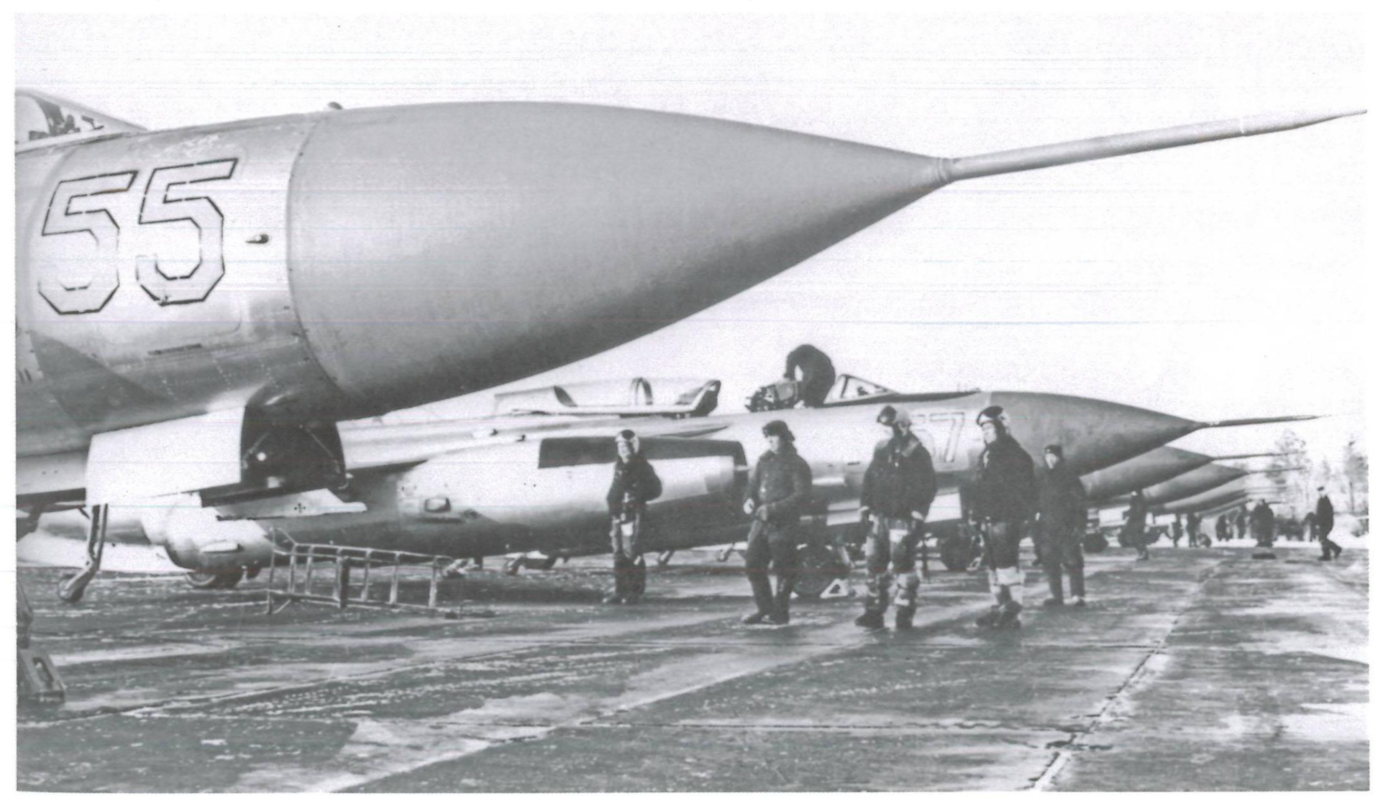
Up to the mid-1960s, the interceptors fielded by the PVO had been handicapped by short range, regardless of whether they were optimised for high or low altitude; in other words, they were intended for point defence. However, there was a need for a long-range interceptor that could take on NATO bombers striking across the North Pole. One more factor to be taken into account was the scarcity of airbases in the High North and the eastern part of the Soviet Union. The answer to this challenge was the Tu-28-80 weapons system (later renamed Tu-128S-4) based on the Tu-128 heavy interceptor.

The 148th TsBP i PLS at Savasleyka AB took delivery of its first Tu-128s in 1964. On 5th September 1965 seven production *Fiddlers* were earmarked for service trials in first-line units. In October 1966 these Tu-128s arrived at Talagi, the main airport of Arkhangel'sk, which is also a military base hosting a PVO fighter unit. This evaluated the Tu-128S-4 weapons system between 18th May 1967 and 29th October 1968. Other PVO units followed soon. As of 1st August 1967 there were 64 Tu-128s in first-line service.

Originally the PVO intended to deploy more than 25 units equipped with the Tu-128 along the Soviet Union's northern, eastern and south-eastern borders; the southern and western sectors were adequately covered by other interceptor types. In reality, however, no more than six Tu-128 regiments were formed; each unit comprised three squadrons with nine to twelve aircraft each. Three of these regiments (the 72nd GvAP at Amderma, the 445th AP at Arkhangel'sk-Talagi and the 518th AP at Savvatiya AB near Kotlas, all part of the 10th

Yak-28P '60 Blue' flies an overwater mission. Note the data link aerials of the GCI system on the tailcone.

Yak-28P crews wait for their aircraft to be ready for the day's flying.



A Yak-28P with R-8M1 missiles

PVO Army) were stationed up north, protecting the Soviet Navy's North Fleet bases and the aerial frontiers of the nation's European part. Two more units reporting to the 14th PVO Army were based in Eastern Siberia (the 64th AP at Omsk-Severnyy airport and the 350th AP at Belaya AB near Bratsk) and the final one (the 356th AP) at Zhana-Semey AB near Semipalatinsk, as the Semipalatinsk nuclear test range constantly attracted the unwelcome attention of Western spyplanes. Curiously, these six units lost the letter I (for *istre**bit**el'nyy* – fighter, used attributively) in their designations after converting to the Tu-128. In the early 1970s the units started taking delivery of Tu-128UT trainers, which facilitated conversion training considerably and improved flight safety.

From an early stage of their service career the Tu-128s were quite active. Ten *Fiddlers* from each regiment formed the forward echelon of air defence, the PVO assets in the borderside areas counting as the first echelon and those in the inner regions as the second echelon. The fully armed Tu-128 toting four missiles could loiter for more than 2.5 hours and pushed the outer limit of the intercept range to 1,100 km (683 miles) from the border.

The Tu-128s based up north were the busiest of the lot; they were constantly called

Night scene at a PVO airbase as the crew boards Yak-28P '33 Red' which is powered up by an APA-2M GPU.

Here the same aircraft is seen a little earlier (the intake and pitot covers are still on) in company with a sister ship coded '56 Red'. Both aircraft look new and shiny.

Front view of '33 Red', showing the starboard R-8M1 missile. The crew chief watches as the pilot and WSO climb in.

It's easy to guess who's who in this shot of a Yak-28P crew: the WSO (aka the navigator) has maps sticking out of his pockets!

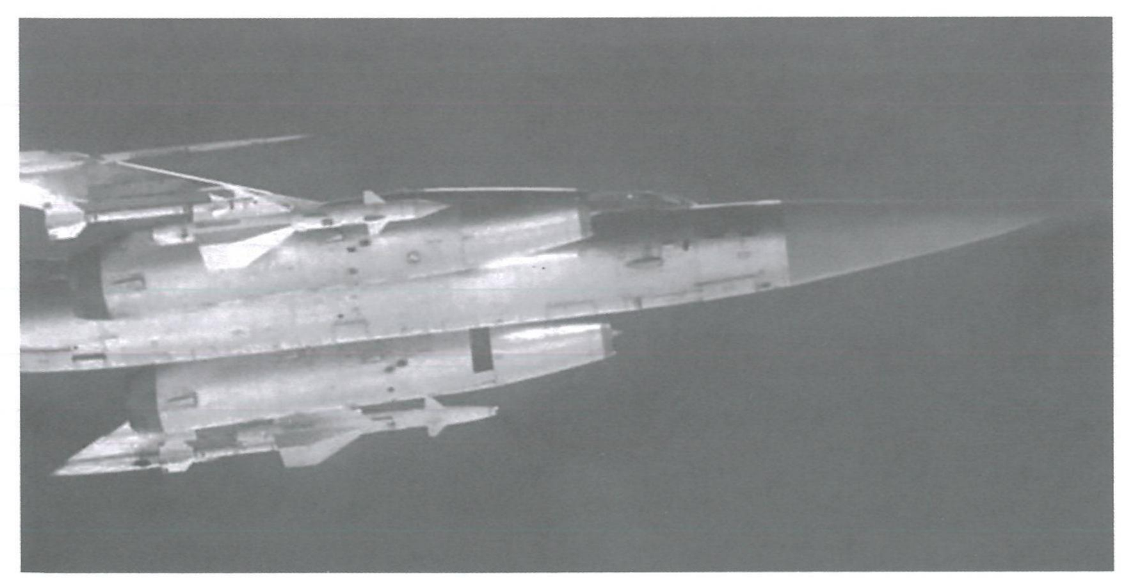
upon to ward off Western reconnaissance and maritime patrol aircraft and provide cover for North Fleet ships. Their adversaries included Lockheed SR-71A reconnaissance aircraft operating from RAF Mildenhall. The Blackbirds regularly prowled along the border, cruising at 3,000 km/h (1,863 mph) and staying within 5 km (3.1 miles) of the Soviet territorial waters. The Tu-128s would fly a parallel course, which would be enough to discourage an incursion.

The only times when the Tu-128s fired in anger was when they were used against drifting reconnaissance balloons; the missiles homed in on the balloon's gondola, which had a high radar signature. A 518th AP crew comprising pilot Maj. V. Sirotkin and WSO Ye. Shchotkin managed to destroy two such balloons in the 1970s; one was shot down off Kolguyev Island, the other near Nar'yan-Mar, and it took all four missiles to finish it off.

The crew of a Yak-28P pose in front of their aircraft.

The Yak-28PM is easy to recognise by its longer conical radome and extra pair of pylons.

Yak-28PM '02 Blue' begins its gear retraction sequence



A Yak-28PM seen in 1973 carries a full complement of AAMs – two R-8Ms inboard and two R-3Ss outboard.

Yak-28PM '01 Blue', 174th GvIAP/Sqn 1, Monchegorsk, the mid-1970s; note the six 'kill' stars for shooting down target drones

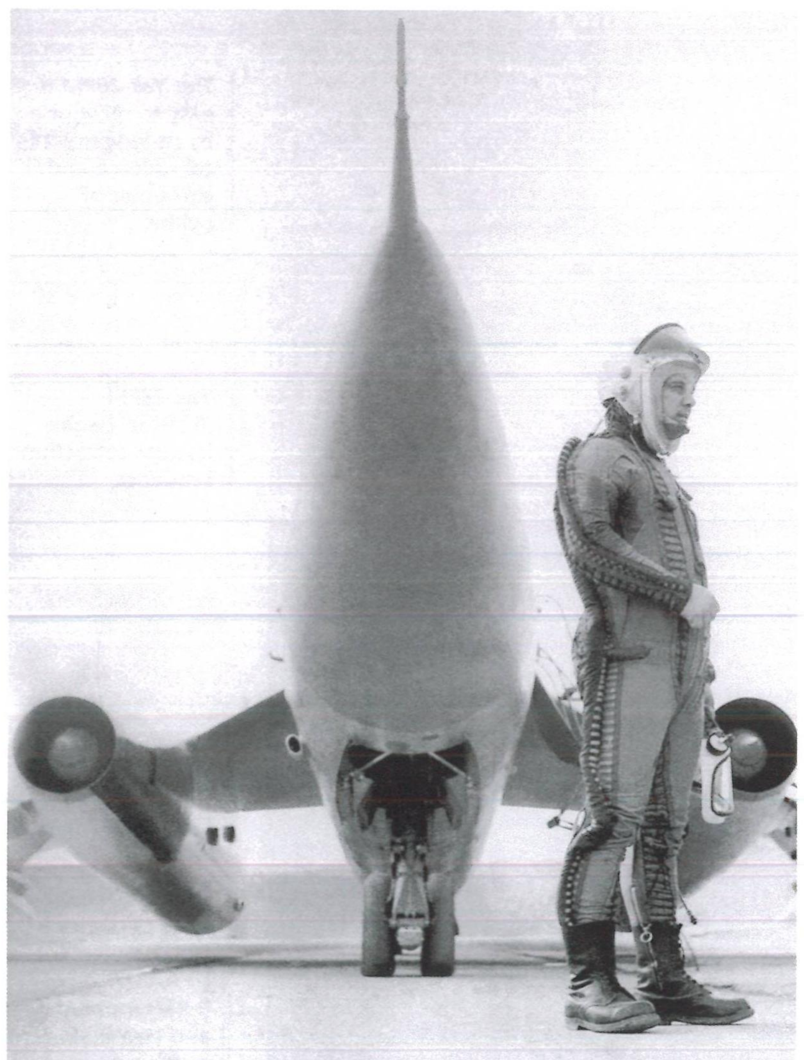
(It may be mentioned here that such shoot-downs occurred in the 1980s as well; on 19th July 1985 a 350th AP crew comprising pilot Maj. N. Savoteyev and WSO Maj. V. Shirochenko shot down a reconnaissance balloon near Yakutsk.) Occasionally Soviet drifting balloons had to be destroyed to prevent them from intruding into Chinese airspace when the wind changed; this was the case in June 1974 when six wayward balloons were shot down by 356th AP Tu-128s near Kustanai, Kazakhstan. The aircraft of Lt.-Col. N. Gaidukov standing on QRA duty was the first to scramble, downing one balloon; however, the six young pilots who took off next all missed their mark. The unit CO Col. Ye. I. Kostenko had to intervene and 'show them how', scoring a 'kill' on the first try. The others were quick on the uptake, and before long all six targets were down. Generally, however, few Tu-128 crews had a chance to make live launches, even against practice targets.

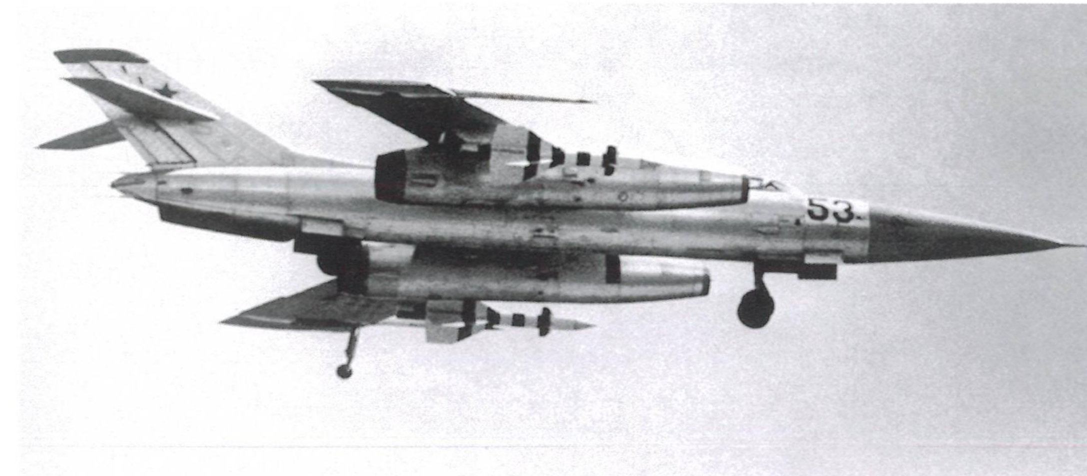
Tu-128 interceptors also participated in the annual Exercise *Okean* (Ocean, pronounced *oki**ahn***) that took Soviet Navy ships across the seven seas. On one occasion a Tu-128 strayed into Norwegian airspace due to crew error during such an exercise, but the aircraft was travelling at Mach 1 plus and the NATO's air defences simply did not manage to catch up with the intruder.

The service routine included practice operations from airfields along the Soviet Union's northern borders used as FOLs. These included Noril'sk (Alykel' airport), Khatanga, Tiksi, Yakutsk (Tuimaada airport), Nar'yan-Mar and even semi-prepared *ad hoc* airstrips; thus, in 1979 three Tu-128s and a Tu-128UT trainer of the 72nd GvAP were on temporary deployment at Graham Bell Island, while in January 1980 four 356th AP aircraft redeployed to Sredniy ('Middle') Island. When the Tu-126 *Moss* airborne warning and control system aircraft entered service with the PVO, Tu-128 crews started intercepting practice and real-life targets, using target information supplied by the AWACS. This was a welcome boost for the *Fiddler*'s capabilities. Taking the idea further, in the early 1970s the PVO experimented with autonomous operations of Tu-128 flights, one of the aircraft (flown by the most skilled crew) acting as a 'mini-AWACS'; MiG-31 units would later use a similar tactic.

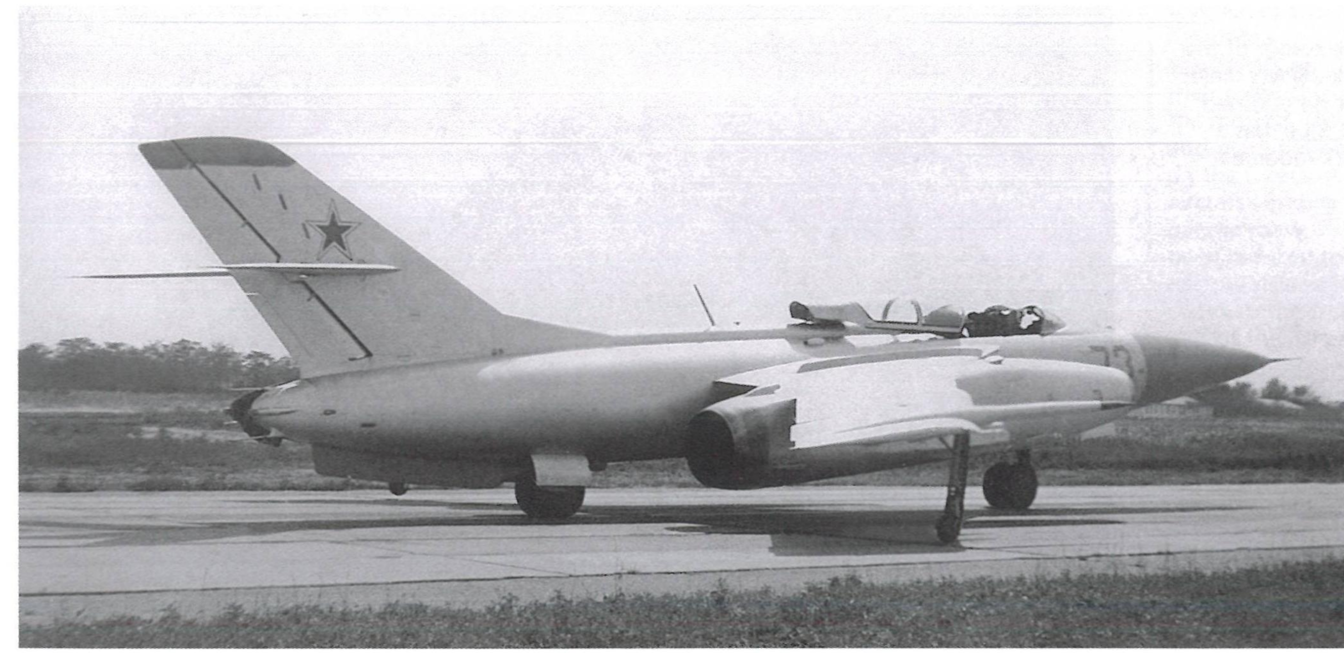
To give the reader a better idea of the Tu-128S-4 (Tu-128S-4M) weapons system's capabilities, it is worth quoting the opinion of a pilot with nearly ten years of Tu-128 operations in his log. Col. Eduard M. Yevglevskiy

This view shows well the shape of the new radome. The pilot is wearing a pressure suit and a GSh-4MS pressure helmet.





Yak-28PM '53' is carrying black-striped inert R-8M1 missiles.



This three-quarters rear view of Yak-28PM '73 Blue' shows the vertically split tailcone housing the brake parachute.

A *Firebar* pilot in winter attire and ZSh-3 helmet signs acceptance of the aircraft in the maintenance log proffered by the crew chief.

Busy scene at a dispersal area as a Ural-375D lorry (number plate 18-86 US) pushes back a Yak-28PM, with three more *Firebars* on the taxiway.

The colour of the Yak-28PM's dielectric parts varied. '34 Blue' has a dark radome…

…while '38 Blue' sports a light grey radome.

Sitting in the sun outside a HAS at Smirnykh AB, this 528th IAP Yak-28PM is being attended by an EGU-3 electric/ hydraulic power unit on a ZiL-130 chassis (left) and an AMK-24/56-131 air handling unit on a ZiL-131 6x6 chassis.

An unusual perspective of two red-coded Yak-28PMs as their crews discuss the mission. The anti-glare panels on the foremost aircraft's engine nacelles have been reduced to narrow stripes; in contrast, the front half of the other aircraft's starboard engine nacelle is entirely black.

Here, Yak-28PM '34 Blue' is about to take off. The Yak-28 needed no rotation for lift-off, having the correct angle of attack on the ground.

Lt (SG) G. Krasikov in the cockpit of his Yak-28PM. The pilot's forward field of view was rather limited.

Here Lt (SG) Krasikov is about to climb in. Note the twin radar screens with rubber sunblinds in the rear cockpit.

was one of the first service pilots to master the *Fiddler*; moreover, he was lucky enough to survive a crash in October 1967, ejecting safely from a stricken Tu-128 in which his WSO lost his life. Later Yevglevskiy became an inspector pilot with the PVO, helping to resolve many problems associated with the Tu-128 and with projected new long-range aerial intercept weapons systems. The following is an excerpt from his memoirs.

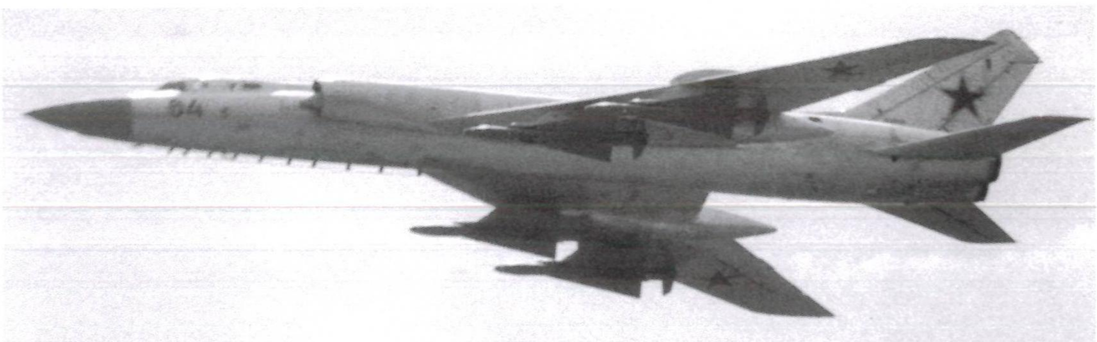
'The transition to an aircraft in the Tu-128's class (a twin-engined heavy aircraft – *Auth.*) *was something of a challenge for the PVO aircrews. The difficulty lay first and foremost in the peculiarities of the control system. Firstly, there was a control wheel instead of the usual*

The same Yak-28PM '34 Blue' in a winter landscape. Unlike the examples pictured on the preceding pages, it has large anti-glare panels on the nacelles.

Yak-28PM '32 Red' taxies at a northern airbase, with mountains as a backdrop. The low clouds show that the landing approach in those parts could be difficult.

Yak-28PM '75 Blue' belonging to the 528th IAP is seen parked outside its HAS at Smirnykh AB.

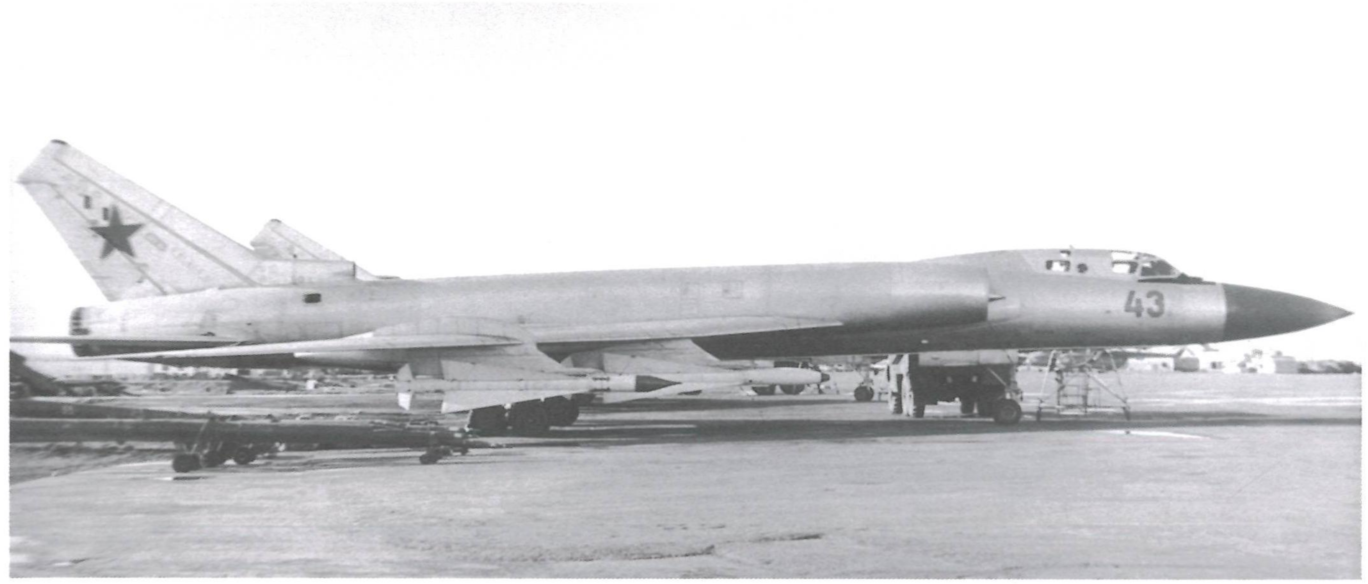
Tu-128s coded '31' and '04' seen during the Moscow-Domodedovo airshow on 9th July 1967. Again, the R-4 missiles are painted red to make them more conspicuous.

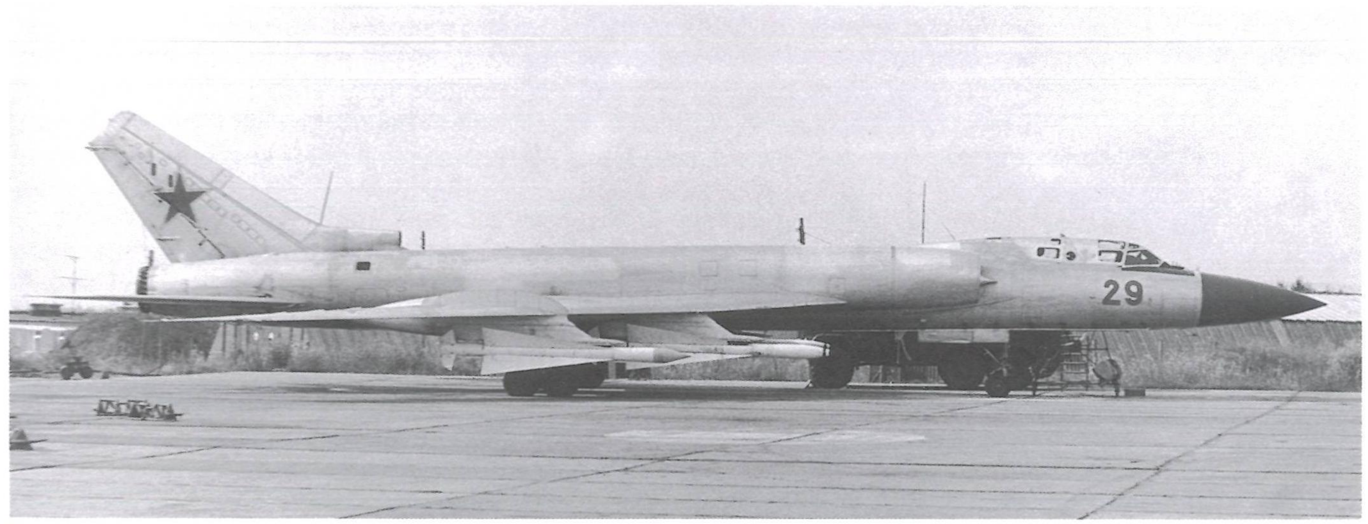


fighter-type control stick; secondly, the wheel brakes were operated by the rudder pedals instead of the customary grip on the stick. The aeroplane's size and considerable inertia also caused a few problems; the pilots were quite unaccustomed to the aircraft's slow response during the landing approach. This was compounded by the aircraft's poor roll control at low speeds in landing configuration. Coupled with the fairly high approach speed, the poor controllability complicated the approach procedure.

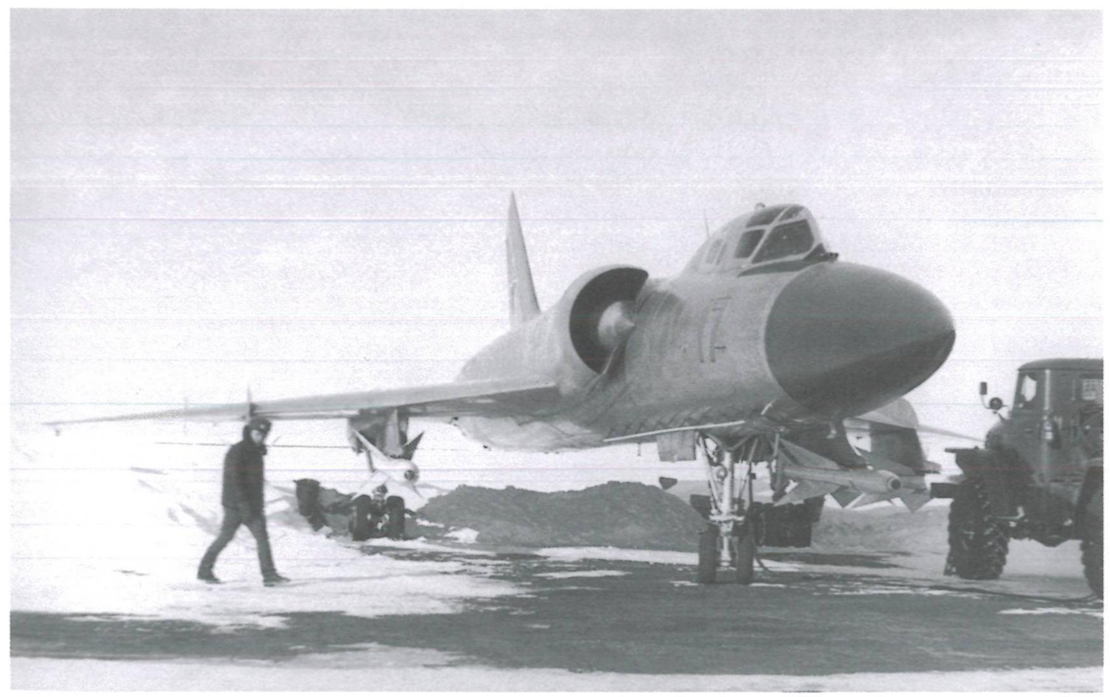
For pilots converting [to the Tu-128] from the MiG-17 (and Yevglevskiy was one of them – Auth.) *the landing approach was extremely difficult. This category of pilots found it very hard to maintain the correct angle of attack during take-off, especially immediately after lift-off in full afterburner with a maximum take-off weight, when the AOA would reach*

Tu-128 '34 Blue' taxies with two missiles on the inboard pylons.

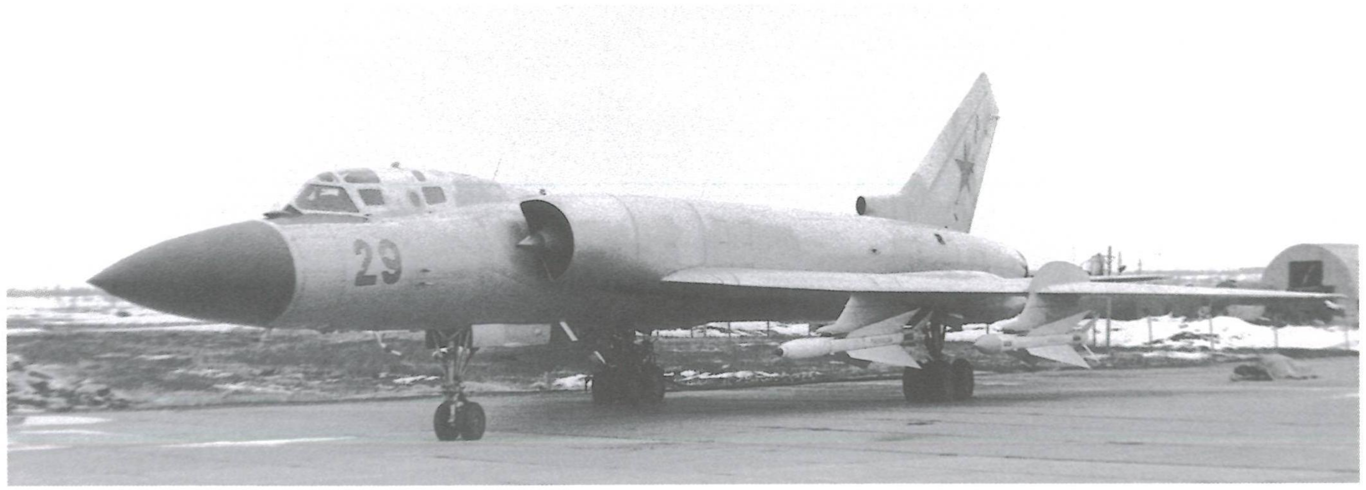


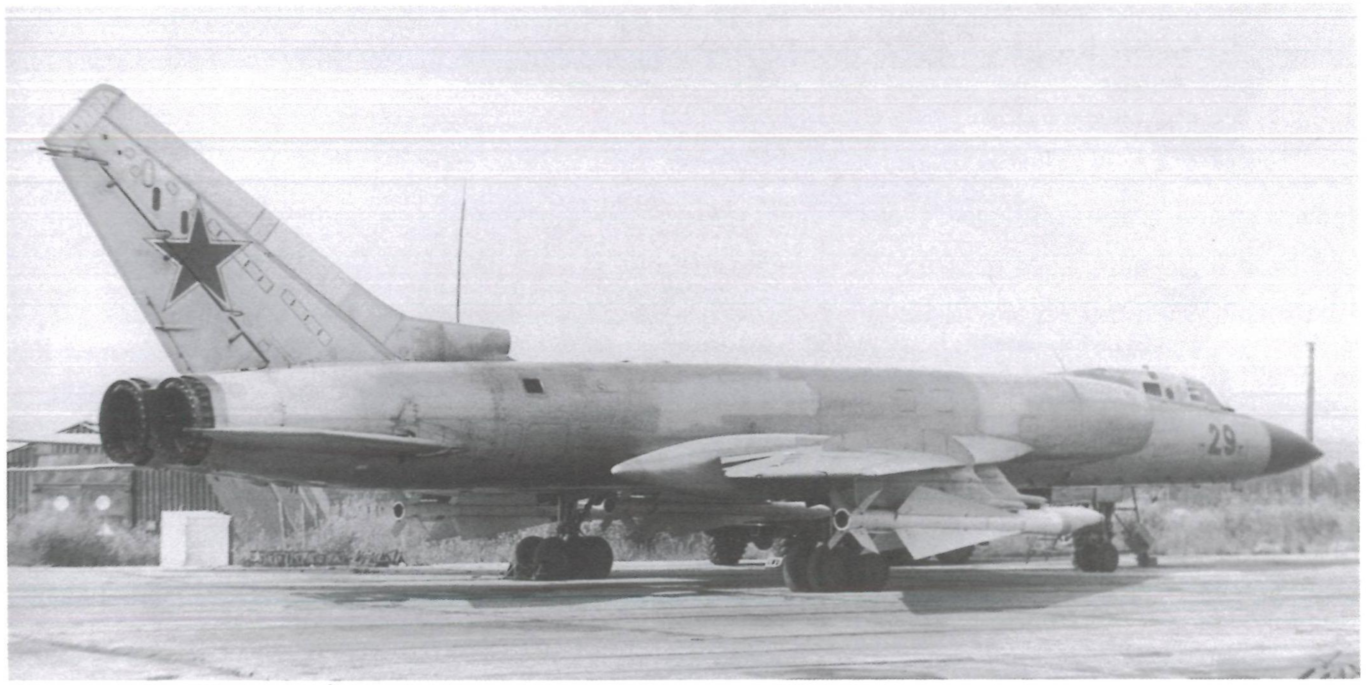


Tu-128s '43 Blue' and '29 Blue' with IR-homing R-4T missiles inboard and radar-homing R-4Rs outboard.



Tu-128 '17 Blue' is ready for engine starting on a snow-covered hardstand.





Two more views of '29 Blue' depicted on the preceding page.

Head-on view of a Tu-128 illustrating the air intake design.

16° after the aircraft left the ground. At this point the aircraft accelerates quickly, in spite of the high AOA, and the pilot has to remove one hand from the wheel in order to retract the undercarriage and flaps. No wonder that the aircraft would start banking immediately.

Retracting the flaps on take-off was an especially complex procedure. That is, you had to be careful not to exceed the maximum flaps-down speed of 450 km/h [279.5 mph] if you were to avoid ripping the flaps off (this actually happened on several occasions). The only way to maintain this speed was by increasing the AOA. If, by mischance, you were going too fast, you had to increase the AOA to 20-25°. After flying the MiG-17 it was really scary to do this at low altitude.

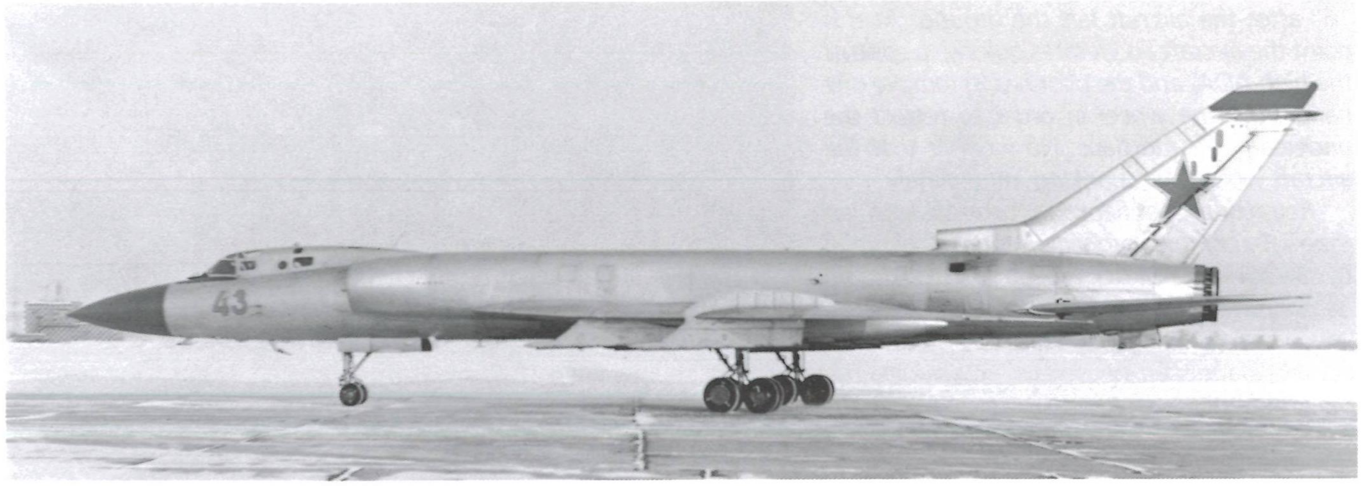
The lack of a trainer (the Tu-128UT did not exist yet – *Auth.*) *compelled the PVO Aviation command to introduce an "experience census" for pilots transitioning to the Tu-128. You had to hold the Pilot 1st Class grade and have at least 400 hours' total time on jets in first-line units (the time logged in the flying college did not count).*

I don't know whose idea it was, but the state acceptance trials protocol stated that "...the Tu-128 is easy to fly, hence no trainer [version] is required..."

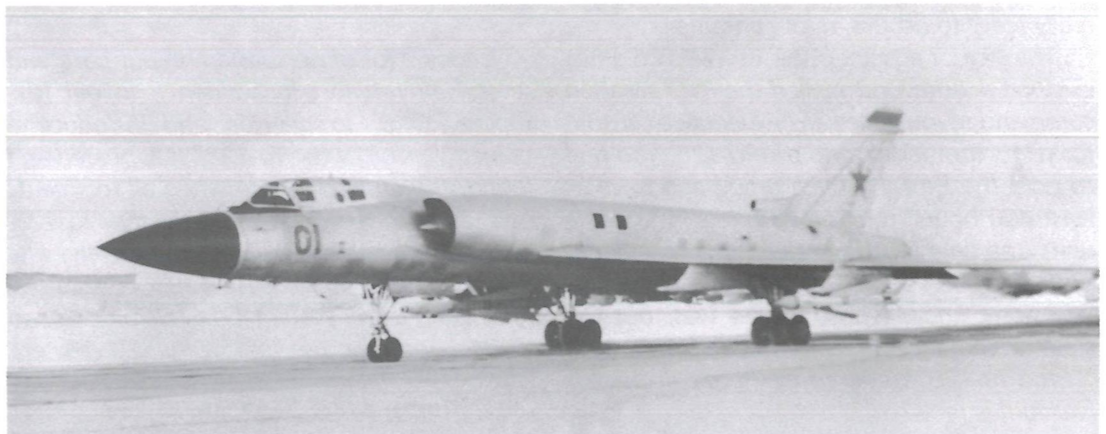
A Tu-128 armed with two R-4Ts takes off. Note the open anti-surge doors.

It took a lot of persuasion on our part, and several aircraft lost in accidents, to get [the Tupolev OKB] to develop and introduce a trainer [version of the Tu-128]. It appeared and found its way into service when all regiments had already re-equipped with the Tu-128. Until then, we had had to familiarise the first group of pilots with the [Tu-128's] control system, using the [Il'yushin] IL-14 [piston-engined airliner] and then the Tu-124 [twinjet airliner]. Later we obtained a single Tu-124 per regiment (the Tu-124Sh navigator trainer version)

The airmen of the 64th IAP/Sqn 1 pose with one of the unit's Tu-128s at Omsk-Severnyy.



The Tu-128M is easy to identify by the reshaped fin tip with a dielectric fairing for the R-863 radio's antenna.



A Tu-128M with R-4MR missiles on the outboard pylons.

and were forced to hastily upgrade fighter pilots to QFIs on this. This instructor training effort was a saga in itself, but there was no other way to master the Tu-128 in service. Even though the Tu-124Sh was referred to condescendingly as "a big UTI-MiG-15" in the units, it bore the brunt of the familiarisation flights during the en masse conversion of air regiments [to the Tu-128]. (The 356th AP had two Tu-124Sh's coded '15' and '25' which, by way of fancy, had been christened, respectively, *Lyus'ka* (a demotic form of the name Lyudmila) and *Matilda*. Later they were transferred to the 350th AP and the 64th AP respectively – *Auth.*)

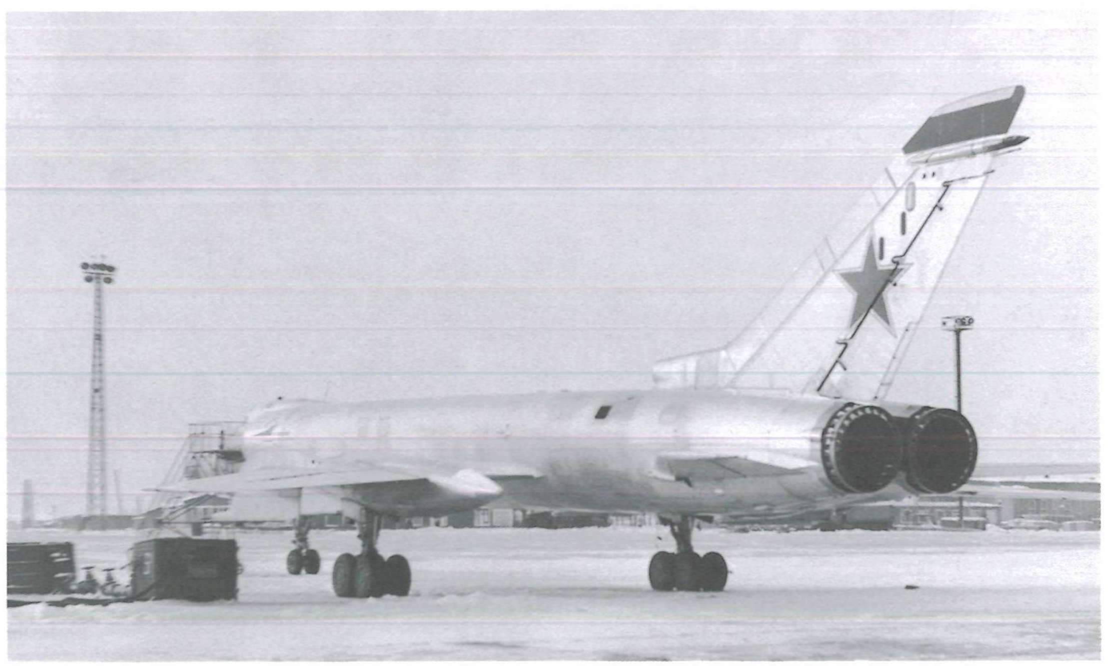
Pilots who had flown the Su-9 were the most willing to convert to the Tu-128 – and were the fastest to master it, too. Consider that the engines were virtually the same, the take-off and approach speeds were identical, but the Tu-128 had two engines instead of one and nearly three times the Su-9's fuel capacity.

The pilot now had an assistant – the WSO – sitting behind him. True, for a long time the fighter pilots were reluctant to resort to the WSO's assistance, but presently they realised that now they could pass part of the workload to their buddy who handled the navigational tasks in the best fashion. When they had mastered the intercept technique in head-on mode, the Tu-128 pilots grew mighty proud of themselves, feeling the power of their new weaponry. The part which everyone liked best was that now it was no longer necessary to climb to the target's flight level – you could destroy the target while flying 3,000-4,500 m [9,840-14,760 ft] below it.

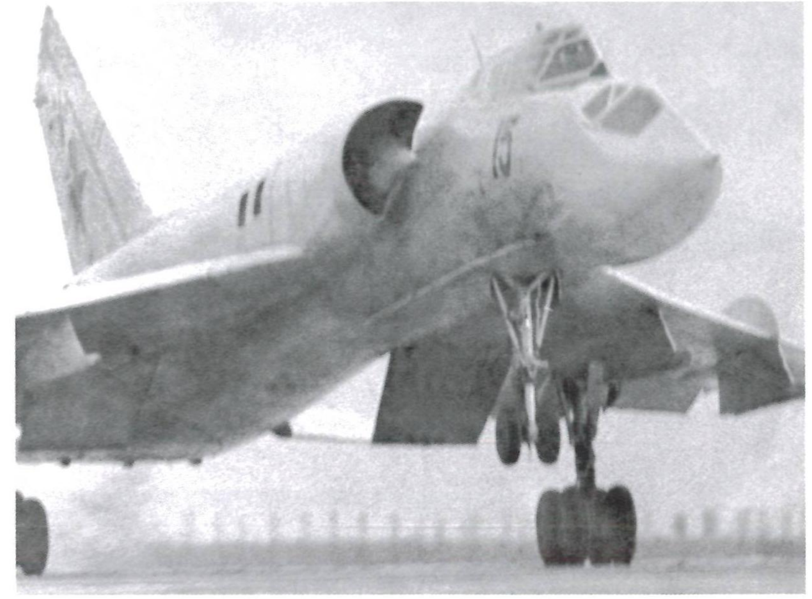
It should be noted that the Tu-128's armament and weapons control system surpassed those of all other PVO aircraft in every possible parameter, be it effective 'kill' range, target altitude, all-aspect engagement capability, target lock-on range or target acquisition range. Low-altitude operations capability was poor, but this shortcoming was rectified when the Tu-128 was upgraded to become the Tu-128M.

If you want my personal impression of this aircraft, I'd like to say that I spent a very large piece of my life with this excellent aircraft, and I cannot throw it away or forget it. From the first minutes when I started mastering this Fiddler *I was thrilled by the power of its motion and the feel that you are controlling this power and weight with your hands and brainwaves. There was that tremendous acceleration on take-off and that swift climb. The Tu-128 would go supersonic at 10,000-11,000 m [32,810-36,090 ft] at full military power.*

In the PVO aviation, the Tu-128 and later the Tu-128M raised a multitude of glorious military pilots who have every reason to be proud of their high flying skills and of the fact



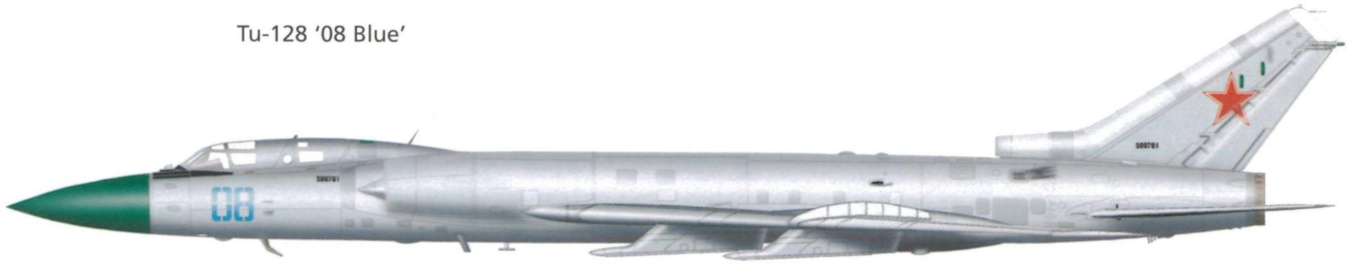
Three-quarters rear view of a Tu-128M. Note the tall boarding platform.



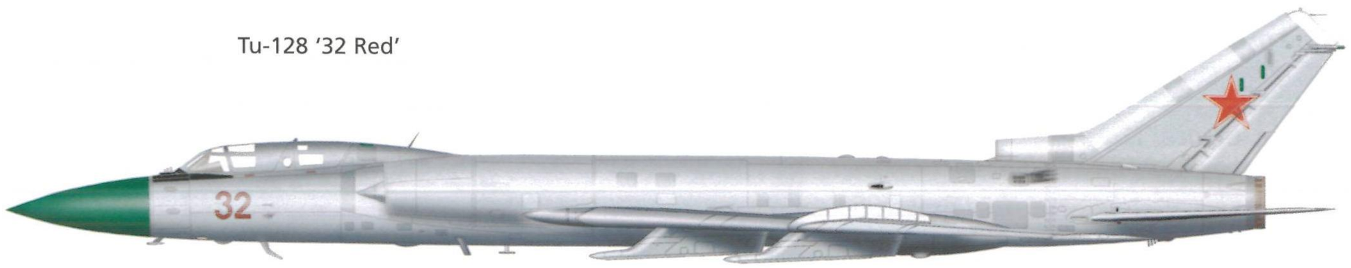
A Tu-128UT trainer about to become airborne.

This view shows well the Tu-128UT's distinctive drooped nose housing the third cockpit for the instructor that earned it the nickname 'Pelican'.

Tu-128 '08 Blue'



Tu-128 '32 Red'



that, flying these aircraft, for the first time they gave their homeland full protection of the vast northern frontiers against air strikes.'

Starting in the late 1970s, the *Fiddler* was progressively withdrawn, giving place to the MiG-31. The Tu-128s were either scrapped on site or relegated to a storage depot and eventually disposed of in the 1990s.

In the 1970s the Soviet Air Defence Force began introducing a new generation of high-performance interceptors – the MiG-23M (followed later by the MiG-23ML and the MiG-23P) and the MiG-25P, which was the world's fastest and highest-flying interceptor at the time (followed by the improved MiG-25PD/MiG-25PDS for reasons described below). New versions of older types also entered service at this point – specifically, the Su-15T and Su-15TM; the ultimate version of the *Fishbed*, the MiG-21*bis*, also saw service with the PVO in the 1970s, which had at least one regiment equipped with the type.

Bird's eye view of the hardstand of a Tu-128 unit. The interceptors' cockpits, air intakes and rear fuselages are under wraps.

Tu-128M '75 Blue'

Tu-128M '45 Blue' with R-4RM and R-4TM missiles

New tactics were adopted and new AD radar sites were commissioned to guide the interceptors. Also, as mentioned earlier, the Air Defence Force introduced its first AWACS – the Tu-126; the type was operated by a single specialised squadron at Šiauliai, Lithuania. Operating in concert with the Tu-126, interceptors armed with long-range AAMs could attack NATO bombers armed with stand-off missiles before the latter came within striking distance of their Soviet targets.

On 30th April 1965 the Council of Ministers issued a directive formally placing the Su-15-98 aerial intercept weapons system (the pure-delta Su-15 *sans suffixe* interceptor and the R-98 AAM) on the PVO inventory. The directive required the Novosibirsk aircraft factory No.153 to launch production of the new interceptor in early 1966.

The Soviet Ministry of Defence and PVO top brass had a lot riding on the Su-15, which was to replace several obsolete aircraft types in the inventory. Following the usual practice, the 148th TsBP i PLS was the first unit to receive the new type; the Centre's 594th UIAP (*oo**cheb**nyy istre**bit**el'nyy **avia**polk* – fighter training regiment) started conversion training for the Su-15 in early 1966. Production was cranking up slowly, and the practice part of the training course could not begin until Sukhoi OKB test pilot Vladimir S. Il'yushin had ferried the second pre-production Su-15 from Zhukovskiy to Savasleyka AB on 28th October 1966. By the end of the year the Centre's pilots had made 14 flights in this aircraft.

Deliveries of production *Flagon-As* to the 594th UIAP began in January 1967. Since no dual-control version of the Su-15 existed yet, conversion training had to be undertaken using single-engined Su-9U delta-wing trainers. Yet, even these were scarce and were badly needed by the operational units, so swept-wing Su-7U trainers had to be used instead. In May 1967 service pilots started taking conversion training in the Su-7U before making their first solo flights in the Su-15.

In the spring of 1967 a display team was formed at the 148th TsBP i PLS specially for an airshow at Moscow-Domodedovo airport which was to take place on 9th July; the team included from the 594th UIAP, as well as from the Centre's command & control squadron

A Tu-128 crewman wearing a VMSK-3 thermally insulated suit for over-water operations, 1972.

Tu-128 '24 Red' parked in an earthen revetment.

and first-line units. The display team temporarily moved to Zhukovskiy together with its aircraft in order to make training flights with dummy R-98 missiles. The rehearsals did not go without incident; on 4th July one of the fighters lost a missile together with the pylon after pulling into a steep climb. It turned out that the aircraft had exceeded its operational G limit by far, and it was no wonder that the pylon had broken off. Examination of the airframe revealed substantial permanent structural deformation and the aircraft was declared a write-off. To prevent further incidents the actual display flight at the show was performed without missiles and with smoke generator pods on the fuselage hardpoints instead of drop tanks.

Su-15 deliveries to operational PVO units began in the spring of 1967. The 611th IAP of the Moscow PVO District based at Dorokhovo AB (Yaroslavl' Region) was the first to re-equip. The 62nd IAP based at Bel'bek AB on the Crimea Peninsula, the Ukraine, followed in July; the 54th GvIAP at Vaïnode AB, Estonia, re-equipped shortly afterwards.

Under the conversion training programme one pilot for each Su-15 would be trained within a six-month period to perform combat

This Tu-128 coded '05 Red' has canvas covers on the radome and pylons, the outer ones carrying missiles. Note the jet blast deflector at the back and the doors in the revetment wall leading to support equipment storage rooms.

445th AP Tu-128s on the military apron at Arkhangel'sk-Talagi, with a military An-26 light transport and Aeroflot Yak-40 airliners in the background.

Clouds of snow billow behind the revetment as a Tu-128 ground-runs its engines.

72nd GvAP *Fiddlers* at Amderma; the unit operated a mix of Tu-128s *sans suffixe* and Tu-128Ms.

duty in daytime visual and instrument meteorological conditions and in VMC at night. This proved difficult to accomplish; to hasten the training process, instructors were seconded to first-line units from the 148th TsBP i PLS.

The strategic bombers operated by the US Air Force (primarily the Boeing B-52 Stratofortress) and the Royal Air Force (the Vickers Valiant, Avro Vulcan and Handley Page Victor), as well as the Hound Dog (USAF) and Blue Steel (RAF) supersonic air-to-surface missiles carried by these aircraft, were envisaged as the principal targets which the Su-15 would have to deal with. As a dogfighting machine the Su-15 was no good, as it lacked the agility – but then, it was not designed with dogfights in mind. The addition of R-60 heat-seeking short-range AAMs to the Su-15's weapons arsenal did not increase its chances in the event of an encounter with enemy fighters but still improved the probability of a 'kill' against a typical target.

MiG-23M pilots in pressure suits and GSh-6 pressure helmets pose with their fighters wearing a two-tone tactical camouflage.

130 Su-15s were in service with eight regiments by June 1968. A total of 149 pilots were qualified to fly the type but less than 50% of them were fully trained to perform combat duty in IMC in the daytime and only two (!) were able to fly night sorties. During training special attention was given to engagements in head-on mode, as this type of attack was new for Soviet interceptor pilots. Live weapons training at the weapons range near Krasnovodsk involving missile launches commenced in April 1967; the 611th IAP's pilots were the first to do so, firing 47 missiles at various practice targets.

The same 611th IAP was selected to hold the obligatory service trials of the new interceptor, which took place from 29th September 1967 to 15th May 1969. During this period the ten fighters involved made a total of 1,822 flights, including 418 under the actual evaluation programme; two live weapons training sessions were held with the expenditure of 58 AAMs. The service trials basically corroborated the results of the state acceptance trials. However, a number of serious shortcomings were discovered; among other things, the service ceiling fell short of the specifications due to the engine thrust decreasing in the course of the engines' service life, and intercept range was also shorter than expected.

In the autumn of 1974 Su-15 pilots started their score of drifting reconnaissance balloons. On 17th October PVO radar pickets detected yet another balloon drifting at 13,000 m (42,650 ft) over the Black Sea and about to enter Soviet airspace. Three 62nd IAP Su-15s took off from Bel'bek AB, making consecutive firing passes at the target; the last of the three managed to shoot off the balloon's reconnaissance systems pod with an R-98T missile. By far the greatest number of such sorties was flown in 1975 – and it was the most successful year as well, 13 out of 16 balloons being destroyed, including five downed by Su-15s.

It should be noted that most of the targets the Su-15 had to deal with were anything but the heavy bombers it had been designed to intercept. As often as not the intruder was a light aircraft which was no easy target for a supersonic interceptor due to the huge difference in airspeeds. To add offence to injury, the intruding light aircraft usually flew at ultra-low level where the interceptor's radar could not get a lock-on; this meant the target had to be located visually, and the view from the Su-15's

Using his hands, a PVO pilot explains dogfight tactics beside a MiG-23M parked in front of a steel jet blast deflector. As per normal practice, the wings are at 72° maximum sweep when parked, and ground power is connected.

cockpit left a lot to be desired. This was where accurate guidance by GCI centres proved crucial.

One of the first such incidents occurred on 21st June 1973. At 0836 hrs local time a radar picket of the Baku PVO District detected a target over Iranian territory 300 km (186 miles) south-east of Baku, moving towards the Soviet border at 2,000 m (6,560 ft). Five minutes later a Su-15 took off to ward off the potential intruder; it was soon joined by two more Su-15s of the 976th IAP which had temporarily moved to Nasosnaya AB near Baku due to runway resurfacing work at their own base at Kyurdamir and a quartet of MiG-17PFUs from the 82nd IAP resident at Nasosnaya AB.

The intruder crossed the Soviet border at 0859 hrs near the so-called Imishli Bulge 170 km (105 miles) south-west of Baku, descending to 200 m (660 ft) to avoid detection by radar. This complicated things considerably for the Su-15 pilots; nevertheless, at 0909 hrs the aircraft, a twin-engined Aero Commander 560 executive aircraft, was detected and hemmed in, landing at Nasosnaya AB 27 minutes later. It transpired that the pilot and the sole passenger were heading from Tabriz to the small borderside town of Parsaabad but had lost their way in the mountains. Well, well…

It was no success story on 25th July 1976 when a 'visiting' Cessna 150 Aerobat got away. At 1913 hrs the low-flying intruder was visually detected by Border Guard troops on the ground – the PVO radar pickets had missed it. At 1927 hrs a 431st IAP Su-15TM piloted by Capt. Vdovin took off from Afrikanda AB. Nevertheless, the Cessna insolently landed at the PVO reserve airfield at Alakurtti which was conveniently close at hand, the crew refuelled the aircraft, using a spare can of petrol, and continued on their eastward quest unhindered.

Approximately at 1950 hrs the GCI centre directed the Su-15 towards the intruder (which had not avoided detection altogether). Due to poor weather Vdovin was forced to fly below the clouds; still, he managed to spot the Cessna but then lost sight of it because of the difference in speeds and could not regain con-

tact. Two more Su-15TMs and a UTI-MiG-15 trainer (!) were never even directed towards the target. Thus the Finnish-registered Cessna flew on for another 300 km into the depths of the Karelian ASSR but then came to grief, flipping over on its back during a forced landing in a clearing in the woods. Soon afterwards the local residents found the crew and made a 'citizen's arrest'; the Finns claimed they had 'lost their bearings'.

A huge scandal erupted within the PVO system. The PVO C-in-C issued an order requiring that the pilots' gunnery training be stepped up; also, to ensure interception of low- and slow-flying targets like this one the QRA flights of Su-15 units was to include an aircraft armed with UPK-23-250 cannon pods by all means. As a result, from 1970 onwards the aircraft in a QRA flight were armed differently (for example, the flight leader carried two missiles (an R-98TM and an R-98RM) and two drop tanks while the wingman had the same complement of AAMs plus two cannon pods.

The Su-15T featuring new cranked-delta wings, a new Taïfoon radar and an SAU-58 automatic flight control system (which enabled automatic flight along several preset trajectories and automated the main stages of the interception process) entered production in December 1970. However, the aircraft was beset by numerous problems associated with the weapons control system and the new blown flaps. As a result, the production run was limited to a mere 20 aircraft and the delivery of the production Su-15Ts dragged on for more than 12 months due to the need to rectify these defects. The aircraft did not become operational until the summer of 1972. Most of them were eventually transferred from active duty to the Stavropol' Military Pilot College for training purposes, with the consent of the Air Force and the Ministry of Aircraft Industry.

The Su-15T was merely an interim type as the Sukhoi OKB had by then brought out the more advanced Su-15TM which, together with the R-98M missile and the Vozdukh-1M GCI system, formed the upgraded Su-15-98M aerial intercept weapons system. The new version was officially included into the inventory by a Council of Ministers directive dated 21st January 1975. It enabled manually- or automatically-controlled intercept of single targets flying at altitudes of 500-24,000 m (1,640-78,740 ft) and speeds up to 1,600 km/h (990 mph) in pursuit mode, and targets flying at 2,000-21,000 m (6,560-68,900 ft) and up to 2,500 km/h (1,550 mph) in head-on mode. The weapons control system had enhanced ECM resistance; on the minus side, the Su-15TM's service ceiling had decreased from 18,500 m (60,690 ft) – the figure obtained in the course of the state acceptance trials – to 17,970 m (58,960 ft).

The first lot of production Su-15TMs was delivered in the spring of 1972. Gradually, together with the MiG-25P heavy interceptor (see below), the Su-15 ousted the outdated Su-9, Su-11, Yak-28P and MiG-21PFM from the PVO inventory. The *Flagon* saw service with units stationed in almost all borderside regions of the Soviet Union, the High North and the Far East receiving the highest priority. The Su-15TM remained one of the principal fighter types defending these vital areas for many years.

By the end of 1975 the PVO intended to re-equip 41 fighter regiments with the Su-15, whereupon the new interceptor would make up nearly 50% of the PVO's aircraft fleet. However, when Su-15 production ended in early 1976, the type was in service with only 29 units, 18 of them operating the Su-15 *sans suffixe* and 11 units flying the Su-15TM.

Quite a few PVO units operated the MiG-23M, which was the most widespread version of the *Flogger* in the Soviet inventory. One of the reasons was that the Su-15 interceptor was not available in sufficient numbers to satisfy the needs of the PVO. The 401st IAP based at Smolensk-Severnyy AB was the first to take delivery of the MiG-23M in March 1976. It was followed in the same year by the 22nd GvIAP at Tsentral'naya-Ooglovaya AB (in the Far East), the 179th GvIAP at Krasnovodsk, the 201st IAP at Minsk-Machoolishchi AB, the 301st IAP at Kalinka AB (also known by the rather strange name *Desyatyy oochastok* – 'Tract Ten'), the 412th IAP at Dombarovskiy and the 425th IAP at Haapsalu. (The 179th GvIAP is something of a mystery, as there was also the 179th IAP – that is, not a Guards unit – at Stryy in the Ukraine, which likewise re-equipped with the MiG-23M (in 1980), and regiment numbers were normally not duplicated!) The 152nd IAP based at Ak-Tepe, Turkmenia, and forming part of the 17th PVO Air Division converted from the MiG-19PM to the MiG-23M in 1977 or 1978. Other MiG-23M units in the PVO were the 656th IAP at Tapa, Estonia (1977), the 177th IAP at Lodeynoye Pol'e near Leningrad (1980), the 689th GvIAP at Neevenskoye AB (1977) and the 735th IAP at Khanabad (Uzbekistan).

Later, when the Mikoyan OKB brought out the lightweight MiG-23ML powered by a new engine, this version entered service with the PVO as well. Moreover, a derivative tailored to the PVO's requirements was developed as the MiG-23P. The PVO units mostly re-equipped with these variants in the 1980s (except the 472nd IAP at Kursk-Vostochnyy airport, which reportedly received the MiG-23P in 1979).

A widespread custom in Soviet times was for industrial enterprises to hold so-called 'socialist competitions', vying for the best results in the industry as regards productivity and output. Winning such a contest was a matter of no small prestige. In the Armed Forces, a similar practice existed with regard to combat training. The 764th IAP based at Perm' (Bol'shoye Savino airport) ranked among the best in the PVO in the 1970s. In 1972 this unit transitioned from the MiG-19PM to the brand-new MiG-25P. In keeping with the unwritten rule the unit's CO, Merited Military Pilot Col. G. P. Pastukhov, was the first to fly a sortie in the new interceptor. In 1977 the 764th IAP received a commendatory pennant 'For Bravery and Gallantry' from the Minister of Defence in recognition of its excellent combat training results.

The advent of such a superfast and ultra-high-flying interceptor as the MiG-25P was a major milestone both in the development of the Soviet Air Defence Force and in the military confrontation between the Soviet Union and the USA. This warrants a more detailed account.

The *Foxbat-A* was officially included into the inventory on 13th April 1972. The MiG-25-40 aerial intercept weapons system based on the MiG-25P and the R-40 AAM took the capabilities of the PVO to a wholly new level. Never before had the Soviet Union been in possession of an aircraft with a top speed of Mach 3 and a service ceiling close to 30,000 m (98,430 ft). This effectively put an end to incursions of NATO aircraft into Soviet airspace.

The MiG-25P saw service with fighter regiments stationed near Moscow, Kiev, Perm', Baku and Rostov, as well as in the High North and Soviet Far East. Once the *Foxbat* had been deployed, the flights of SR-71A strategic reconnaissance aircraft along the Soviet borders became much less frequent. Occasionally the Blackbirds were in real danger – the MiG-25's missiles had achieved a lock-on and the target was within 'kill' range. The reason why no order to fire had been given was that

Opposite: MiG-23M '08 Red' in air superiority grey finish, with a concrete blast deflector behind it. Note the anti-glare panel ahead of the forward-looking infra-red (FLIR) sensor.

An enamel badge marking the 40th anniversary of the 472nd IAP. Typically, it does not show the unit number, stating simply 'PVO unit', but it does feature a stylised MiG-23.

A pair of grey-painted MiG-23Ms with the wings at 45° cruise setting. Each aircraft carries four R-3S AAMs.

This front view illustrates clearly the MiG-23ML's wing dogtooth energising the airflow at high angles of attack (specifically, during combat manoeuvres) and the unusual horizontal position of the main gear struts on the ground.

A publicity shot showing the pilot of '41 Red', a MiG-23M sporting the 'Excellent aircraft' badge, at maximum alert.

Opposite: Two MiG-23Ms in the maintenance hangar of a PVO unit.

MiG-23Ms '25 Red' and '20 Red', each armed with four R-3Ss, make a high-speed dash with the wings at maximum sweep.

Camouflaged MiG-23Ms on the flight line.

there was no incursion – the SR-71s stayed over international waters.

By the mid-1970s the MiG-25P had become the mainstay of the PVO's fighter arm. It was popular with flight and ground crews alike; the pilots liked its docile handling and willingness to forgive minor errors, while the tech staff appreciated the MiG-25's ease of maintenance. The interceptor earned such affectionate nicknames as *chemo**dahn*** (suitcase) and *gastro**nom*** (food store). While the former sobriquet was obviously derived from the MiG-25's angular and massive appearance, the other nickname was due to the fact that *liquors* are sold in food stores – and the MiG-25P's radar and generator cooling systems contained more than 200 litres (44 Imp gal) of alcohol/water mixture.

As for active duty, MiG-25P operations were quite intensive, especially in the High

MiG-23M '22 Red' taxies out for a night sortie past a sister ship.

Opposite, top: A dramatic night shot of MiG-23M '07 Blue'.

Opposite: A pair of MiG-23Ms of the QRA flight. '21 Red' is armed with four R-13M missiles.

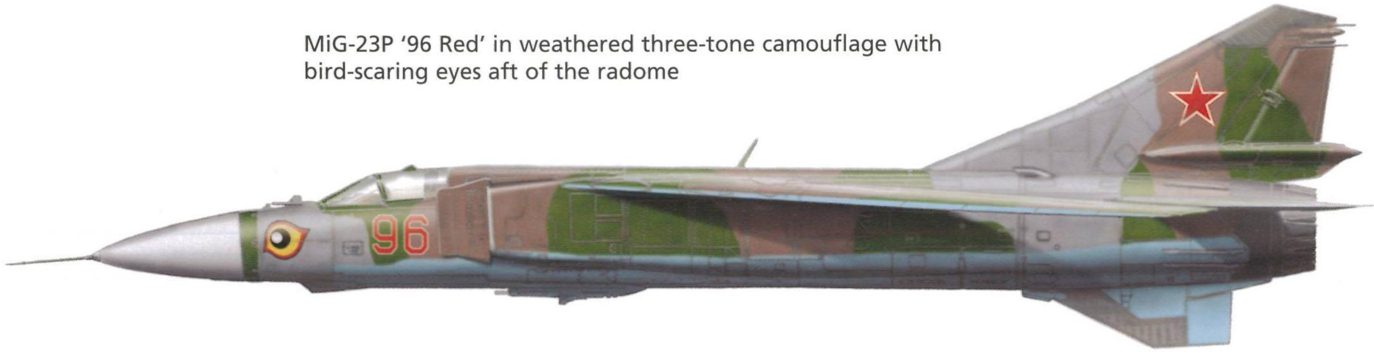
One more view of '21 Red' – this time with two missiles.

MiG-23M '51 Blue' in air superiority grey colours

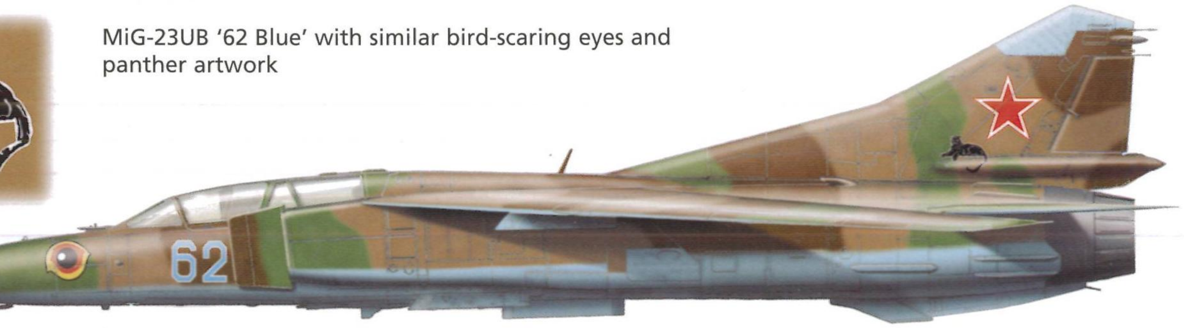
North and the Far East, involving round-the-clock QRA duty and occasional scrambles. This placed high demands on the crews.

On 6th September 1976 an unfortunate event occurred which had a profound effect on the MiG-25's career. The notorious Lt. Viktor I. Belenko defected to Japan in a MiG-25P belonging to the 530th IAP based at Chugooyevka AB north of Vladivostok. The Soviet government made the Japanese authorities return the purloined aircraft, but not before the MiG-25 – the Soviet Union's most secret aircraft at the time – had been dismantled and studied by US intelligence experts. When the Soviet experts found out just how much the West actually knew, the Soviet government, the Ministry of Defence and the Ministry of Aircraft Industry had to take res-

MiG-23P '96 Red' in weathered three-tone camouflage with bird-scaring eyes aft of the radome



MiG-23UB '62 Blue' with similar bird-scaring eyes and panther artwork

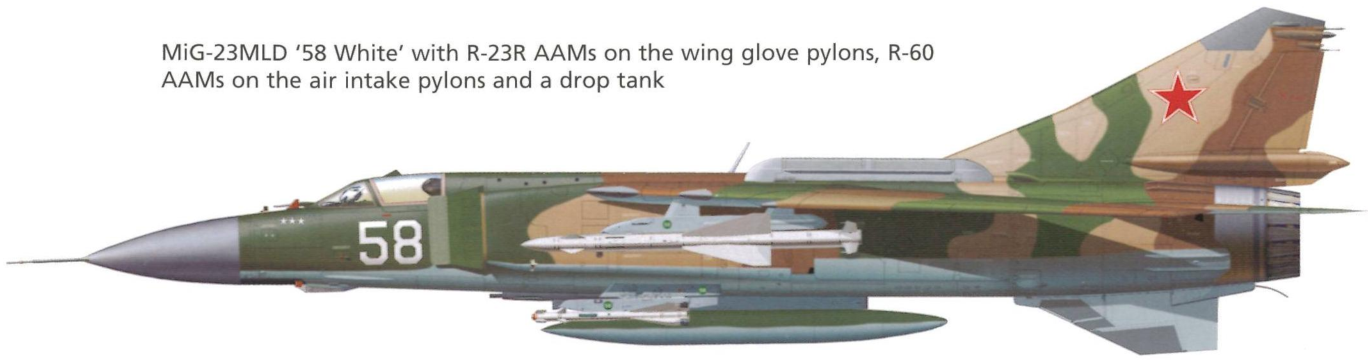


This MiG-23UB in similar finish has a low-visibility tactical code, '54 White outline'

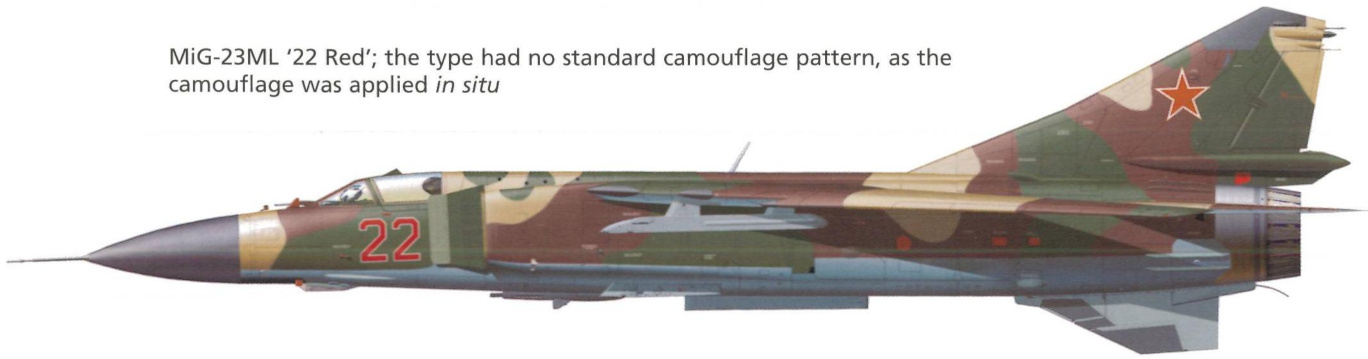
A pilot climbs into MiG-23ML '01 Blue' on a sunny winter day.

Minutes later, wings moved forward to 16° sweep position and leading-edge/trailing-edge flaps lowered, '01 Blue' taxies out for take-off. Note the 800-litre centreline drop tank.

MiG-23MLD '58 White' with R-23R AAMs on the wing glove pylons, R-60 AAMs on the air intake pylons and a drop tank



MiG-23ML '22 Red'; the type had no standard camouflage pattern, as the camouflage was applied *in situ*



olute action. The much-improved MiG-25PD entered production just two and a half years after the notorious defection, and many operational MiG-25Ps were quickly upgraded to the broadly similar MiG-25PDS standard. Another consequence was that the IFF system fitted to Soviet military aircraft had to be redesigned completely. By the end of 1982 the capabilities of the PVO had been not merely restored but actually improved thanks to the higher-performance MiG-25PD/PDS and the new MiG-31 interceptor which had achieved IOC by then.

The MiG-25 was of special importance to the Soviet air defence, since (until the MiG-31 entered service) it was the only aircraft capable of intercepting the SR-71As that prowled over the Barents Sea and especially the Baltic Sea. When a wave of political unrest rolled over Poland in the early 1980s the West feared a possible Soviet military intervention. The data provided by surveillance satellites on Soviet forces stationed along the western borders apparently proved insufficient for the NATO, and the SR-71As began their sorties over the Baltic. MiG-25PDs and MiG-25PDSs stationed in the area bore the brunt of dealing with these snoopers.

As can be seen from the above, in the course of two decades (the 1960s and 1970s) the Soviet Air Defence Force fielded a whole range of up-to-date interceptors that changed the situation completely for the uninvited guests wearing 'stars and bars' or what-not. Whereas in the 1950s the NATO spyplanes (notably the Lockheed U-2) intruded into Soviet airspace with near-impunity, photographing strategic objectives at will, the famous Powers shootdown in 1960 was a clear sign that the Soviet Union would not tolerate such incursions any more. Of course, the West did not stop its reconnaissance activities against the Soviet Union, but these took on a new form in the 1960s; rather than intrude brazenly, NATO reconnaissance aircraft now prowled along the Soviet borders, performing electronic eavesdropping.

The Powers missions

Speaking of the U-2, the PVO was still short of interceptors in early 1960, which allowed the 'Dragon Lady' to perform its missions unimpeded. On 9th April 1960 a U-2A flown by none other than Capt. Francis Gary Powers took off from the US airbase in Peshawar, Pakistan (alias Badaber Air Station). Crossing the Soviet border, it made several passes at 20,000-21,000 m (65,620-68,900 ft) over the PVO test range near Lake Balkhash where the S-75 Dvina (SA-2 *Guideline*) SAM – the one that would soon put a spectacular end to the U-2's incursions – was being tested. Only the fact that there were no live SAMs on site at the

A MiG-23U with an unusual yellow tactical code and an 'Excellent aircraft' badge; note the early Type 1 wings with no leading-edge dogtooth

moment prevented a shootdown. The report submitted to the PVO C-in-C said that 'due to criminal negligence the intruder was not detected by Turkestan PVO Corps air defence radar pickets until 4:47 AM when it was more than 250 km [155 miles] inside Soviet territory'. In reality, however, the radar crews were not to blame, as the radars' field of view was obstructed by mountains.

Of course, the entire Soviet air defence system was in turmoil. Neither PVO interceptors nor the fighters of the Air Force's 73rd VA had been able to stop the intruder. A flight of four Air Force/9th GvIAP MiG-19s scrambled from Andizhan, Uzbekistan, but, with its service ceiling of 16,600 m (54,460 ft), the *Farmer* was no match for the U-2. (Even the specially lightened MiG-19SV could stay at 18,000-20,000 m (59,055-65,620 ft) only briefly and could not manoeuvre at such altitudes in order to make a firing pass at the target.) Two more MiG-19s, this time PVO/356th IAP aircraft, took off from Sverdlovsk (now Yekaterinburg) in the Urals and headed south, intending to make a refuelling stop at Orsk, Orenburg Region (on the border between the Russian Federation and Kazakhstan), before attempting to intercept the U-2. However, Lt. (SG) V. Karchevskiy crashed on approach to Orsk and the mission was called off.

Meanwhile, the U-2 overflew the Baikonur space centre in Kazakhstan and escaped into

This 894th IAP aircraft is not the same '01 Blue' as seen on page 119; it is a MiG-23MLD with an extra dogtooth on the wing glove.

Iran, crossing the border near the town of Maryy, Turkmenia (pronounced like the French name Marie) after spending 6 hours 48 minutes in Soviet airspace with impunity. Two PVO/156th IAP MiG-17s scrambled from Maryy-2 AB to intercept the U-2 over Turkmenia on the off-chance that it might descend on the way back. 73rd VA Commander Gen. Yuriy V. Votintsev and 156th IAP CO Lt.-Col. P. Ye. Koozin authorised the pilots to cross the border in pursuit of the intruder; this is exactly what they did, but to no avail – the target got away. Running critically low on fuel, the pursuers had no choice but to head for home.

The 735th IAP at Khanabad AB near Karshi, Uzbekistan, which was in the process of re-equipping with the Su-9s (and was then the sole *Fishpot* unit in those parts), was also involved in the 9th April incident. A pair of Su-9s piloted by Capt. Doroshenko (leader) and Lt. (SG) Kudelya (wingman) scrambled to intercept the U-2; however, not yet being fully familiar with their mounts and receiving wrong instructions from the command post (which was not yet equipped with the Vozdukh-1 GCI system), the Soviet pilots missed the intruder. This was the pilots' first experience with pressure suits and pressure helmets, and they climbed straight up instead of accelerating to supersonic speed in level flight as required – passing well below the target as a result.

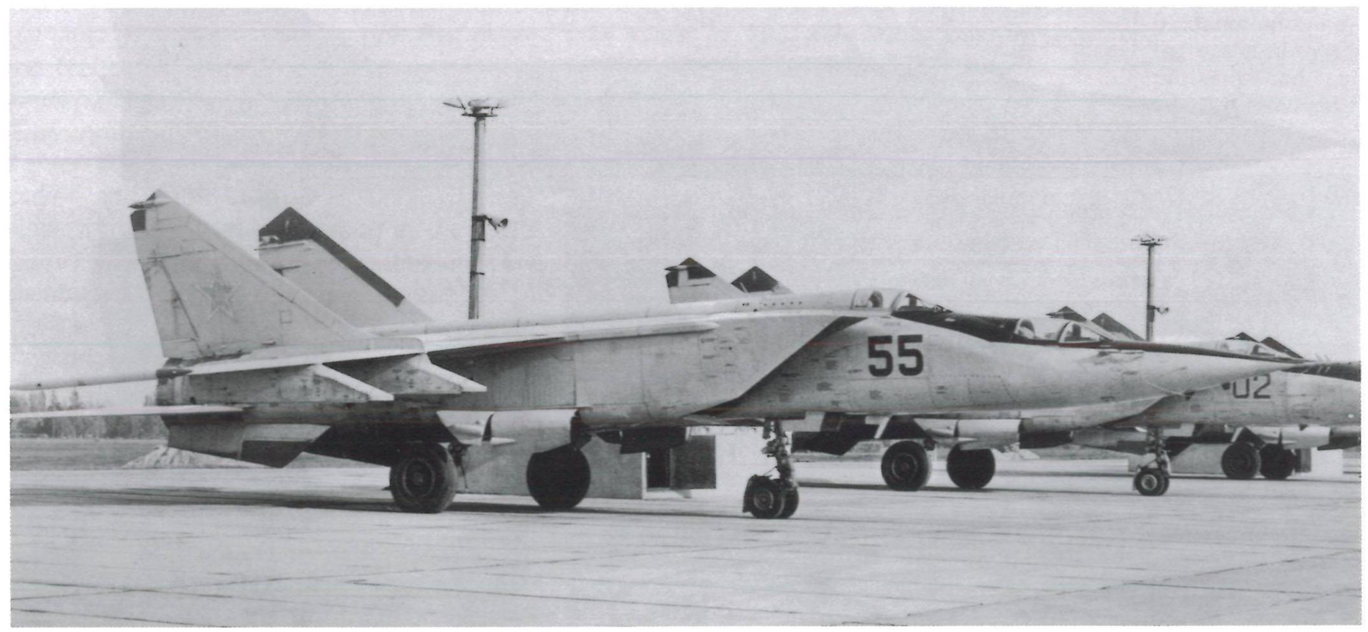
The fate of the Su-9, which had only just completed state acceptance trials and had been recommended for service, now hung by a thread; moreover, the reputation of the Sukhoi OKB and the pilots who had tested the Su-9 was in jeopardy. A special commission arrived from Moscow to investigate the inci-

MiG-25P '16 Blue' shows signs of weathering, with faded paint everywhere except the nose section which is often under wraps.

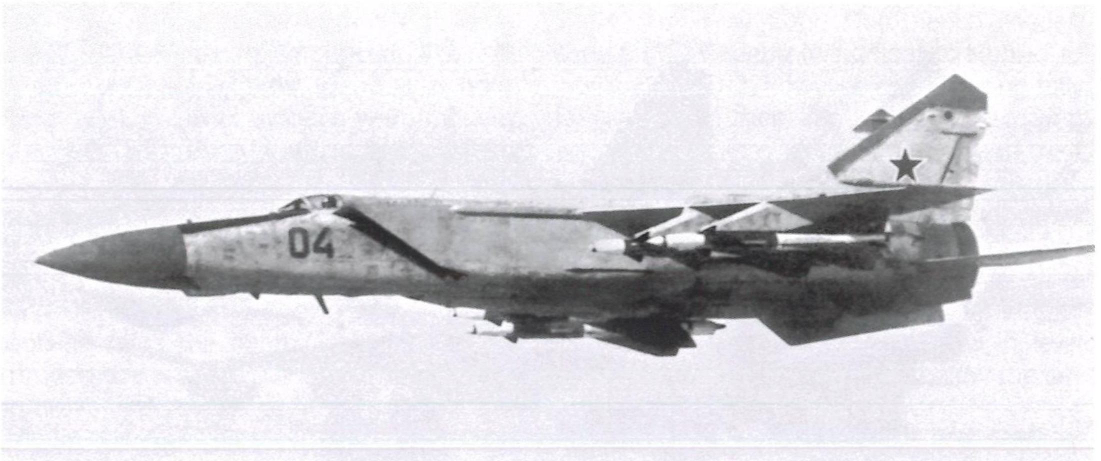
'52 Blue', a MiG-25PD armed with two R-40RD medium-range AAMs and four R-60M short-range AAMs on APU-60-2 twin adapters.

Afterburners blazing, a MiG-25PD begins its take-off run. Note the R-60U fixed acquisition round on the starboard outer pylon.

MiG-25PDs '32 Blue' and '40 Blue' on the flight line.



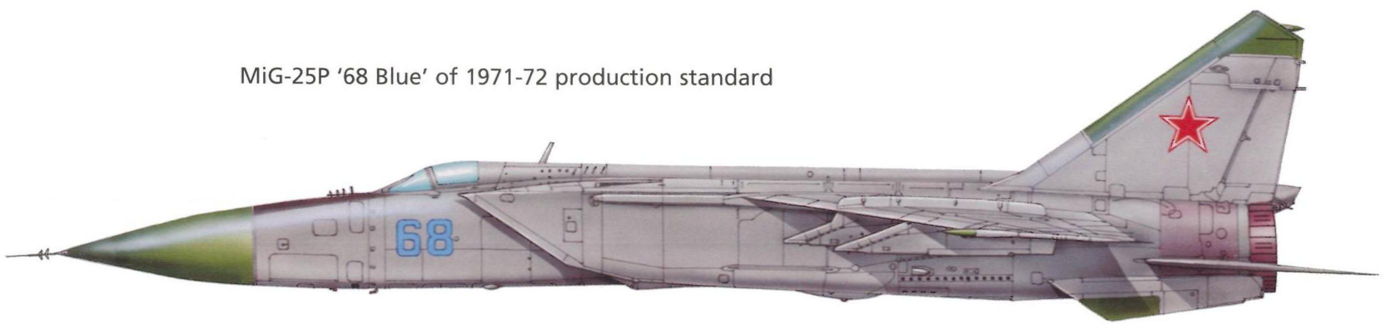
MiG-25PU trainers, such as '55 Blue', were used by the PVO.



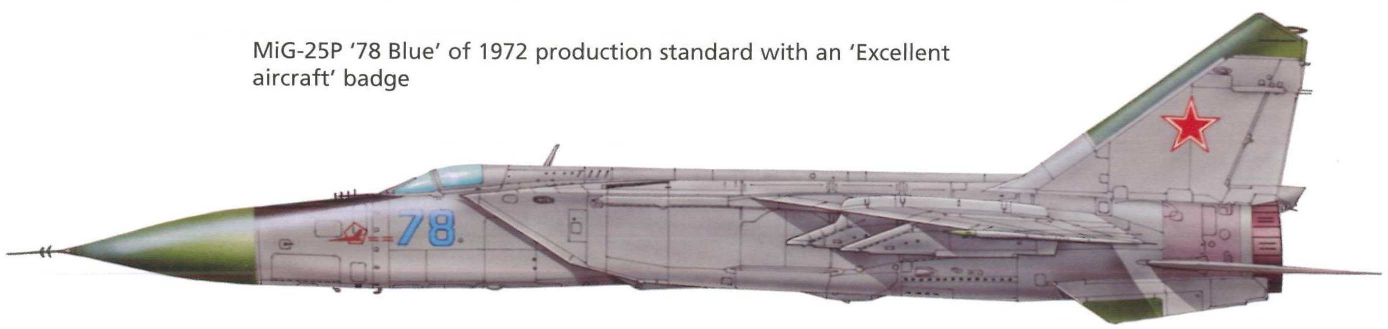
MiG-25PD '04' armed with four R-40TDs/R-40RDs having partially black bodies and black wings. Note the undernose FLIR sensor and associated anti-glare panel.

dent and find the culprit. The commission included test pilots Vladimir S. Il'yushin (representing the OKB) and Leonid N. Fadeyev (representing GK NII VVS); the latter pilot performed a checkout flight, using the officially approved climb technique, and reached the required altitude of 20,000 m. Thus the Su-9 was exonerated completely, and the service pilots were really not to blame either. The PVO top command vented its wrath on the PVO Aviation's Chief of Combat Training Lt.-Gen. Grigoriy F. Pogrebnyak, who was removed from office. For the two weeks that followed, test pilots Il'yushin, Fadeyev, Gheorgiy T. Beregovoy and Nikolay I. Korovushkin maintained combat duty at the

MiG-25P '68 Blue' of 1971-72 production standard



MiG-25P '78 Blue' of 1972 production standard with an 'Excellent aircraft' badge



MiG-25P '31 Blue' of late 1972 production standard; note the grey radome

GK NII VVS facility in Akhtoobinsk, ready to stop a new incursion, should it occur. On 26th April a squadron of Su-9s flown by service pilots arrived in Akhtoobinsk, relieving the test pilots of this duty.

Here it is worth quoting the memoirs of Col.-Gen. (Retd.) Yuriy V. Votintsev:

'In the spring of 1959 the Commander-in-Chief of the Air Defence Force, Marshal Sergey S. Biryuzov, made an inspection trip to the Turkestan Independent PVO Corps. His verdict was that the corps was not combat-capable, and the corps commander was removed from office. Calling his first deputy, Marshal (Artillery) Nikolay D. Yakovlev, on the phone from Tashkent (where the Turkestan Independent PVO Corps HQ was located – Auth.), *Biryuzov instructed him to prepare the papers for my assignment as the new commander of this corps within three days.*

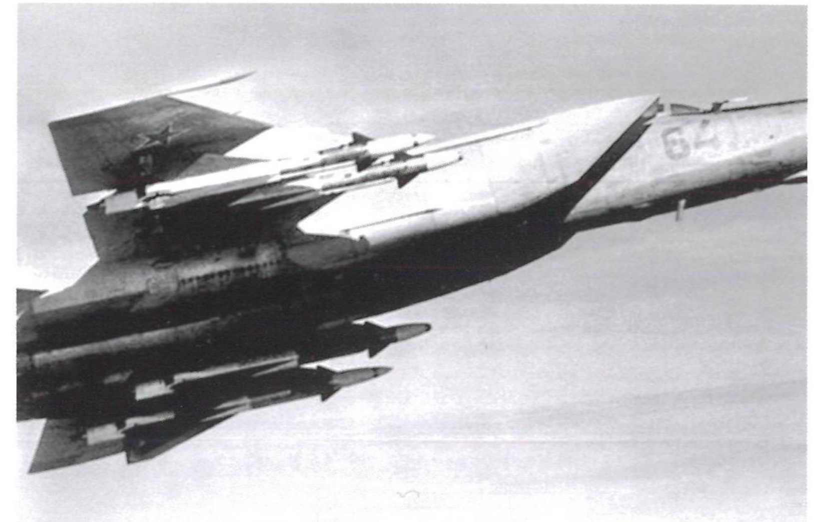
My very first meeting with the command staff of the corps was a depressing experience. The Chief of Staff and the commanders of the PVO arms had a very vague idea of the situation at the unit level. It took me two full months to become acquainted with all the units, including the personnel of the independent radar troops stationed in the mountains along the Osh – Khorog Highway 3,000 to 5,000 m [9,840-16,400 ft] above sea level. My conclusion was that the corps was incapable of fulfilling its assigned mission of protecting the nation's southern frontier.

In the course of a year the command staff of the corps had been completely replaced and bolstered, mainly by the best officers from the Special Mission Army. Together with them I set about clearing up the mess in the individual units. There was only one unit that made me feel proud – the 9th GvIAP stationed at Andizhan and commanded by Lt.-Col. Goryunov. This regiment, the first Soviet fighter ace unit, held its combat traditions sacred and performed its mission diligently. However, there was an episode in the unit's history that alarmed me when the unit CO mentioned it.

The co-located radar troop at Andizhan had only a single P-30 AD radar, which was new hardware by the day's standard. About 18 months before I was appointed corps commander, the operator of this very radar had detected a target flying at 20,000 m [65,620 ft]. Goryunov had sent one of his squadron commanders, a seasoned pilot, to intercept it. Having climbed to 17,000 m [55,770 ft], which was the best the MiG-19 could do, the pilot reported seeing an aircraft of cruciform layout flying about 3,000 m above his own flight level. After this the IA PVO Commander Col.-Gen. Yevgeniy Ya. Savitskiy came to the unit to have a talk with the pilot. Having analysed what he knew about the flight of the mysterious intruder, Savitskiy arrived at the same conclusion as the General Staff experts at the Special Mission Army's command post near Moscow: such an aircraft does not exist, period. The pilot was hastily transferred to another unit; I had no chance to talk to him.

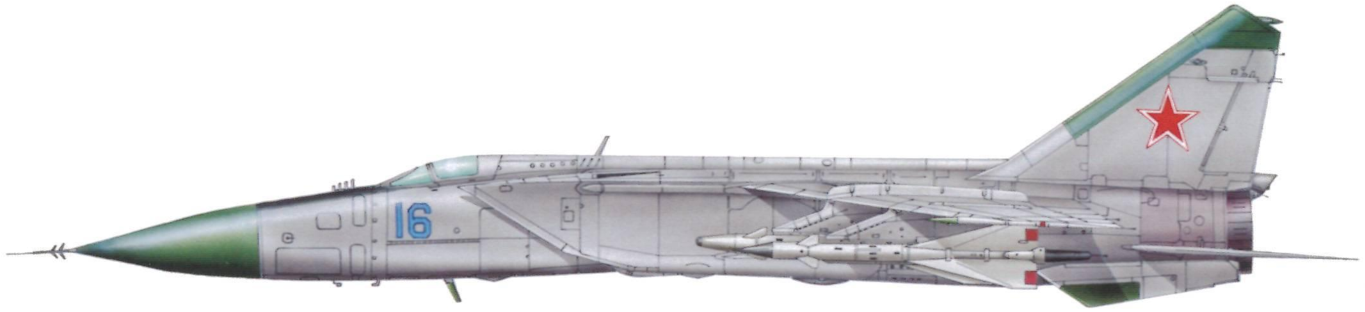
Back then, I had disagreed with the experts, but I had no material evidence to support my opinion. In 1959 I submitted to the PVO C-in-C a report stating the need to re-equip the corps with up-to-date hardware. Soon I received a reply to the effect that my request had been included into the [hardware procurement] plan and that deliveries would take place in 1961-62. Subsequent events, however, forced a change of these plans.

On 9th April 1960 an unidentified aircraft originating from Pakistan crossed into Soviet

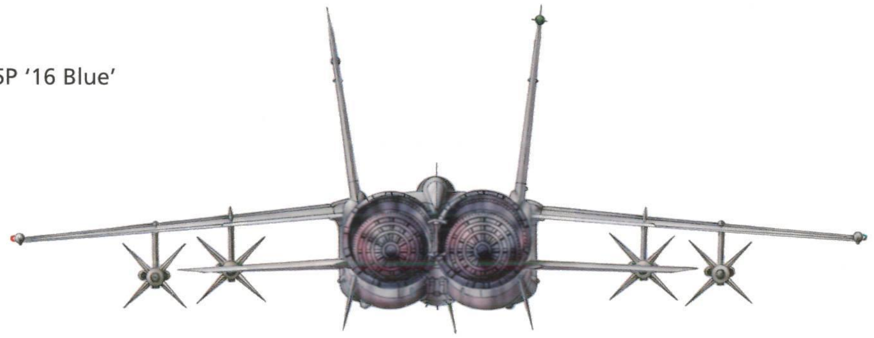


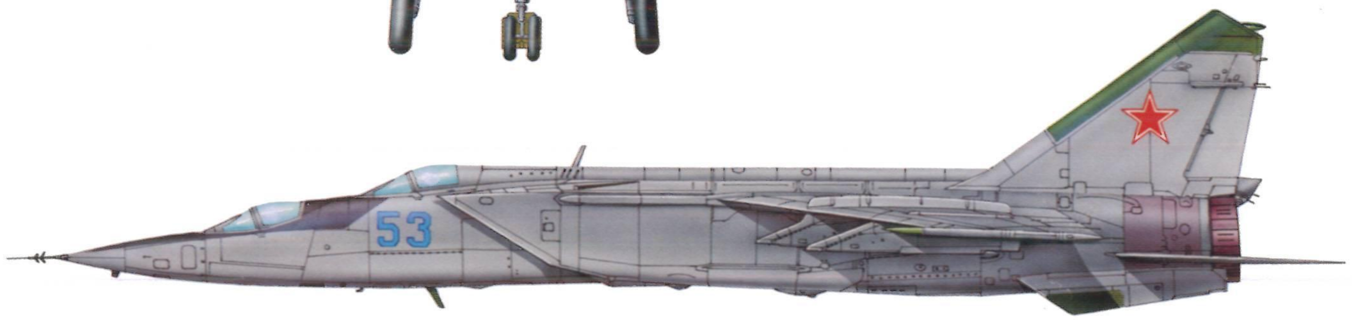
Close-up of the R-40TD (inboard) and R-40RD AAMs on an upgraded MiG-25PDS.

This view shows the bifurcated rocket motor nozzle of the R-40 AAM – a necessity because the tailcone carries the guidance antenna (here, closed by a protective cap which is removed before flight).



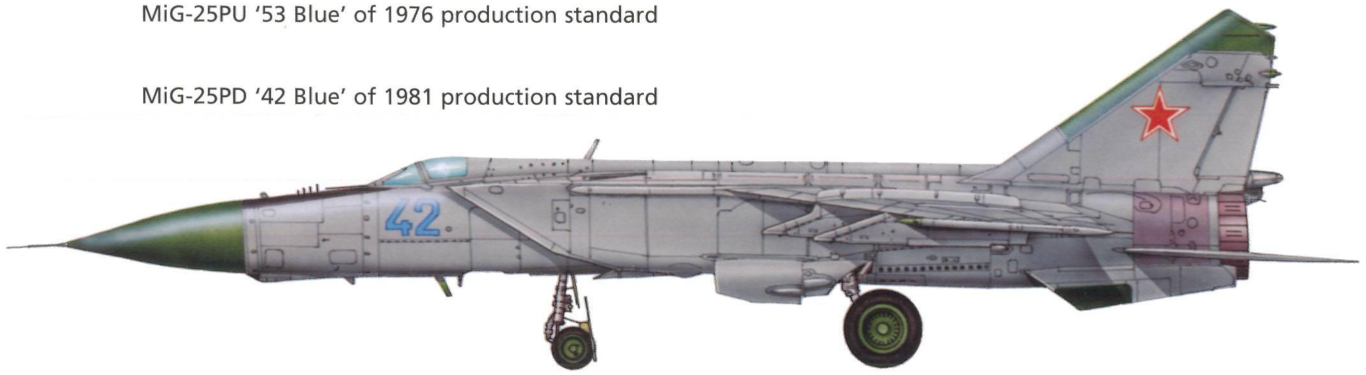
Three views of MiG-25P '16 Blue'



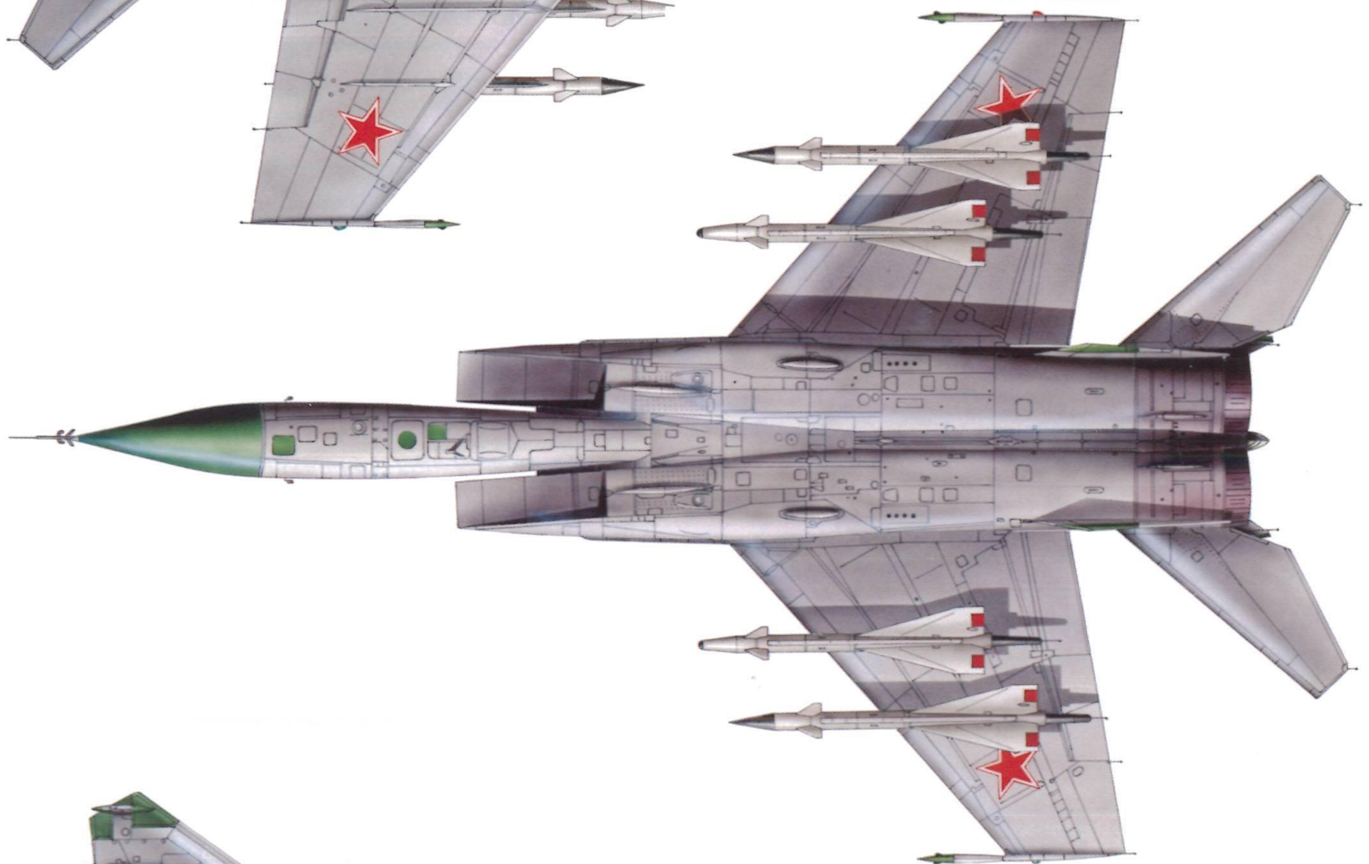


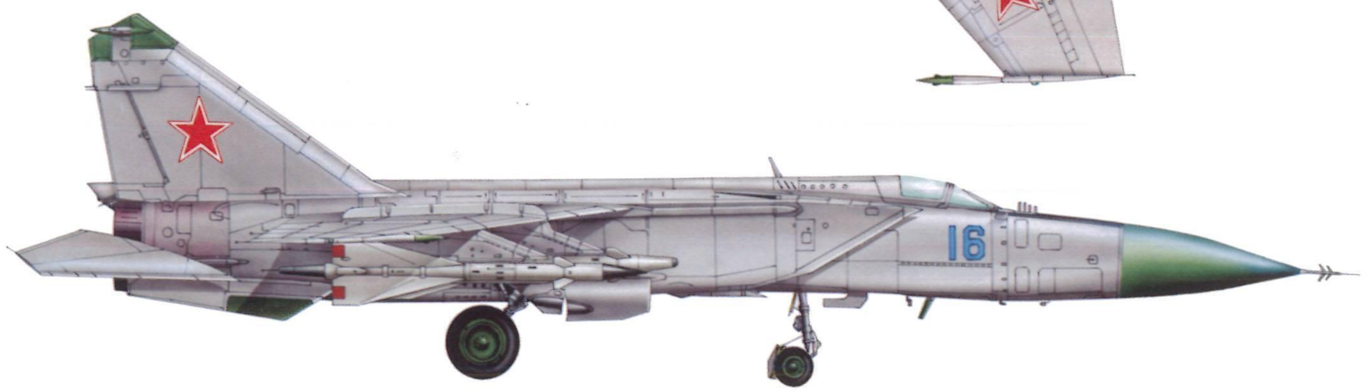
MiG-25PU '53 Blue' of 1976 production standard

MiG-25PD '42 Blue' of 1981 production standard



Three more views of MiG-25P '16 Blue'





A MiG-25P commences its take-off run, the mighty R15B-300 turbojets spouting afterburner flames.

airspace near the Pamir Mountains. As the report of the commission investigating this incursion went, "due to criminal negligence the foreign aircraft was not detected by the radar pickets of the Turkestan Independent PVO Corps until 0447 hrs [Moscow time] when it had penetrated more than 250 km [155 miles] into our territory". In reality, however, the radar of the radar troop inappropriately positioned east of Khorog was unable to detect the target because of strong background clutter generated by the surrounding mountains. The radar picked located at Kara-Kul' further north was the first to make contact with the target and track it reliably. At the time I was at the corps command point, and when the intruder's track was plotted I ordered four MiG-19 fighters sent up from Andizhan to intercept it. Despite receiving GCI guidance, the pilots were unable to spot the target after reaching 16,000 m [52,490 ft].

Next, the intruder made several passes over the PVO test range near Lake Balkhash with impunity. The site where the new S-75 SAM system was undergoing tests had no live missiles at the moment – the range commander Lt.-Gen. (Artillery) Stepan D. Dorokhov had not managed to have them delivered on time from the replenishment depot, which was 80 km [50 miles] away. The intruder changed course, circled over the Baikonur test range (sic – Auth.) *and exited Soviet airspace near Maryy after spending 6 hours 48 minutes over our territory. Neither the PVO nor the [Air Force's] 73rd Air Army were in a position to stop the unprecedentedly brazen incursion – they simply lacked the means.*

An R-40TD and two R-60M short-range IR-homing AAMs on an APU-60-2 paired launcher under the port wing of a MiG-25PD.

From the PVO's Central Command Post I was informed that the C-in-C had stood for six hours beside the [wall] map [on which the intruder's course was being plotted] without saying a word. Only twice Sergey S. Biryuzov had asked me to confirm personally that the intruder's flight level was unchanged at 20,000-21,000 m [65,620-68,900 ft]; this he later reported to the Minister of Defence. As the intruder approached the State border I had an idea that it might descend. I reported this to Biryuzov and received permission to send a pair of MiG-17s to pursue the intruder into Iran. Lt.-Col. P. Ye. Koozin, the CO of a fighter regiment, ordered two of his pilots to chase the intruder beyond the border and destroy the target when it descended – even ram it if they had to. The two MiG-17s penetrated 250-300 km [155-186 miles] into Iranian airspace; yet the intruder did not descend and they were unable to spot it. Turning back, the fighters barely made it back to Maryy-2 AB with almost empty fuel tanks.

On hearing my report [that the intruder had escaped] Biryuzov said that I and the other persons responsible for letting the spyplane survey our two most secret proving grounds would be severely disciplined by the Minister of Defence. He then added: "Keep your chin up. Experience is worth it." (Actually Biryuzov used a modified version of a Russian proverb that has no direct English equivalent. The standard version translates loosely as 'One seasoned man is worth two green ones'; Biryuzov's wording was: *'Here in the PVO, one seasoned man is worth a dozen green ones, not two. Keep that in mind.'* – Auth.)

Incidentally, the Iranian government chose not to make any statements regarding the infringement of Iranian airspace by our fighters (probably knowing it was not in a position to raise a protest; to use a Russian slang expression, the cat knows whose meat it has eaten! – Auth.). *Soon afterwards the Minister of Defence issued an order imposing a penalty on me.'*

On 1st May 1960 Francis Gary Powers ran out of luck while flying another spy mission in a U-2A serialled 56-6693 (c/n 360). Again, the flight had been timed to May Day in the hope that the Soviets would be less vigilant. This time the route, again originating in Peshawar, lay northward across the Central Asian republics to the Urals region; the objective was to reconnoitre the *Mayak* (Lighthouse) Production Association – a plutonium enrichment facility in Ozyorsk, 150 km (93 miles) south-east of Sverdlovsk – and the Plesetsk ballistic missile facility (now a space centre). At first, it looked like the April scenario was going to be repeated. The aircraft entered Soviet airspace near Termez at about 0530 hrs Moscow time, flying at 20,100 m (65,940 ft); PVO fighter regiments stationed along the spyplane's route repeatedly but unsuccessfully tried to intercept it, being equipped with the MiG-19PM. Yet, as the U-2 approached Sverdlovsk, Powers' route took him across the area covered by the 37th and 57th SAM Brigades equipped with S-75s. Both brigades fired a total of eight missiles at the target as it cruised leisurely at 21,740 m (71,330 ft). The first missile launched at 0846 hrs nailed the

'07 Blue', an operational Soviet Air Force MiG-25P, toting a typical ordnance load – two IR-homing R-40Ts inboard and two semi-active radar homing R-40Rs outboard.

Su-15 *sans suffixe* '42 Red'

Su-15 '01 Red' named after Great Patriotic War hero Nikolay Danilenko, 611th IAP, Dorokhovo AB

Three of the five Su-15s *sans suffixe* that opened the flying display at the Moscow-Domodedovo air-show on 9th July 1967. The fighters carry dummy R-98 missiles.

U-2 in the lower rear hemisphere; apparently one more missile scored a hit, finishing off the job, while most of the others missed and self-destructed. Powers ejected and was captured after parachuting to safety near Kosoolino railway station. (To this day, there is considerable controversy as to which SAM battalion actually scored the 'kill' – but this lies outside the scope of this book.)

But that's not all; let us focus on the events immediately before and immediately after the 'kill'. Firstly, the only available aircraft that stood a chance of getting at the U-2 was the Su-9. That day a pair of factory-fresh Su-9s destined for the 61st IAP based at Baranovichi, Belorussia, happened to be staging through Sverdlovsk-Kol'tsovo airport on their delivery flight. (In many accounts of the event these aircraft are mistakenly referred to as 'pre-production T-3s'; T-3 was indeed the manufacturer's designation of the Su-9's immediate precursor known to NATO as the *Fishpot-A* and featuring a different air intake/radome design. However, fact is that the production Su-9 initially retained the product code T-3; it took a while before it was changed to T-43, and the researchers simply didn't know the difference.) The fighters were flown by Capt. Igor' A. Mentyukov and Capt. Anatoliy N. Sakovich (the latter was a 61st IAP pilot).

A Su-15 coded '01 Blue' and carrying two UPK-23-250 cannon pods streams its brake parachute after landing. Note the open anti-surge door aft of the tactical code.

Now, the Su-9's armament consisted solely of AAMs, and of course the fighters carried none on the delivery flight. Also, the pilots were not wearing pressure suits, as the flight proceeded at low level. Nevertheless, in a gesture of despair, PVO Aviation Commander Col.-Gen. Yevgeniy A. Savitskiy expressly ordered Sakovich to take off and ram the intruder; this was, in effect, a suicide mission, as the pilot would be unable to eject without a pressure suit. Yet, with orders at that level, and in view of the mission's importance, the pilot complied. Sakovich took off at 0740 hrs and was directed to a spot 150 km south of Troitsk (the name means 'Trinity Town'). However, the guidance proved to be inaccurate and the pilot failed to find the target. After hitting 'bingo fuel' (running critically low on fuel) Sakovich landed at the dirt strip in Troitsk.

(Interestingly, when recounting this episode for the Belorussian MoD monthly magazine Armiya (Army), Col. Nikolay P. Filatov (Retd.), a former pilot with the 61st IAP, put it as follows. *'Many a time we received unmanned "presents" in the form of drifting reconnaissance balloons. [...] But the balloons are as nothing compared to Capt. A. Sakovich. There's a might-have-been Talalikhin for you!* (Lt (JG) Viktor V. Talalikhin was a Red Army Air Force fighter pilot who, having run out of ammunition, rammed a Heinkel He 111H with his Polikarpov I-16 near Podol'sk on the night of 27th October 1941 to stop the German bomber from reaching Moscow. He lost his life in so doing and was posthumously awarded the HSU title. – *Auth.*) *Few people are aware of the fact that Sakovich nearly downed the U-2 of the [Francis Gary] Powers who had dared to spoil the May Day celebrations for our country in 1960.*

That day Anatoliy Nikolayevich [Sakovich] was at one of the military airfields near Sverdlovsk. He was then a flight commander and was ferrying Su-9 supersonic interceptors to his unit's home base from the Novosibirsk aircraft factory. Sakovich was ordered to scramble and intercept, even though his aircraft was carrying no missiles; yet he had orders to attack in any way he could – even ram [the adversary] if necessary! And he would have rammed it if ground control had

A PVO pilot poses for a publicity shot with his Su-15. This view shows well the *Flagon-A*'s conical radome.

Su-15 '01 Blue' carrying zebra-striped dummy R-98s is refuelled on the taxiway of a Soviet airbase. Note the open brake parachute housing doors.

'Can't find the darn place on the map... just point your finger!' This view illustrates the Su-15's distinctive splayed air intakes.

not bungled: the [GCI] navigators were unable to guide the interceptor properly to the target.

The intruder then entered the area protected by the SAM guys, who walked away with the prize. This, as you know, had grievous consequences for our aviation. "We do not need aeroplanes like these!"– said an angry Nikita Sergeyevich [Khrushchov] and placed his bets on the missiles, ordering the [fighter] air regiments to be disbanded. But, to give the Minister of Defence due credit, Sakovich was not left out in the cold – for his bravery he received a gold watch from the Minister [of Defence].' (A gold watch with an engraved commemorative inscription from the command was no mean reward for the flying personnel in those days, and such gifts were given for saving the aircraft after an in-flight emergency – or for acting properly in exceptional circumstances like these.)

Next, Mentyukov was ordered up at 0810 hrs (some sources say 0814 hrs) with identical orders – 'destroy at any cost'. He agreed, asking only that his family be taken care of. The GCI post of the 101st IAD at Uktus (this is now the other airport of Yekaterinburg) did the guidance; yet, once again ground control failed to guide the unfamiliar fighter properly. Accelerating to 2,200 km/h (1,367 mph), Mentyukov climbed to 20,750 m (68,080 ft) and found himself 10-12 km (6.2-7.5 miles) from the target, which was flying 2,000 m (6,560 ft) above him, but soon overtook the slow U-2. (Russian MoD records state that the Su-9 came up on the target's anticipated track between the cities of Miass and Kyshtym at 0830 hrs, but just then the U-2 changed course, heading north towards Kyshtym.) Attempting to put the situation right, the ground controller ordered the pilot to cancel the afterburner; as a result, the Su-9 lost speed and 'fell through'. Since Mentyukov did not have enough fuel to make a repeat attack, he had no choice but to return to Kol'tsovo, landing at 0852 hrs. After being refuelled, at 0952 hrs he was ordered up once more (!), which was utterly pointless because the U-2 had already been destroyed.

A Polish Air Force officer examines the cockpits of a visiting Su-15UT trainer as his colleagues watch a Su-15TM coming in to land during one of the type's few foreign deployments in the course of a Warsaw Pact exercise.

(It may be mentioned that much later, in 1996, Mentyukov came up with a fish story – circulated by the media – that it was he who had downed the target *with the wake of his jet by crossing in front of the U-2*! Imagine that! Also, he claimed that his aircraft was mistakenly fired upon by the 57th Brigade's SAM Battalion 1 located at Monetnyy township and commanded by Capt. Shelud'ko, and that he barely managed to take evasive action. Yet this, too, is a statement open to doubt; Mentyukov was flying at low level and at right angles to the U-2's course, and he could not have seen the incoming missiles.)

Secondly, the victory was marred by a tragic incident caused by lack of co-ordination between the various PVO units. At 0843 hrs a pair of 356th IAP MiG-19s piloted by Capt. Boris Aivazyan and Lt (SG) Sergey I. Safronov scrambled from Sverdlovsk-Kol'tsovo, where they had made a refuelling stop en route from Perm'-Bol'shoye Savino. They did not manage to reach the U-2 before it was destroyed – nor could they have, for that matter, due to the MiG-19's performance limitations. Afterwards,

'No malfunctions.' A Su-15 pilot writes his comments in the maintenance log after a sortie for the aircraft's crew chief. Note the early-style maintenance award legend 'Otlichnyy' (Excellent) on the nose.

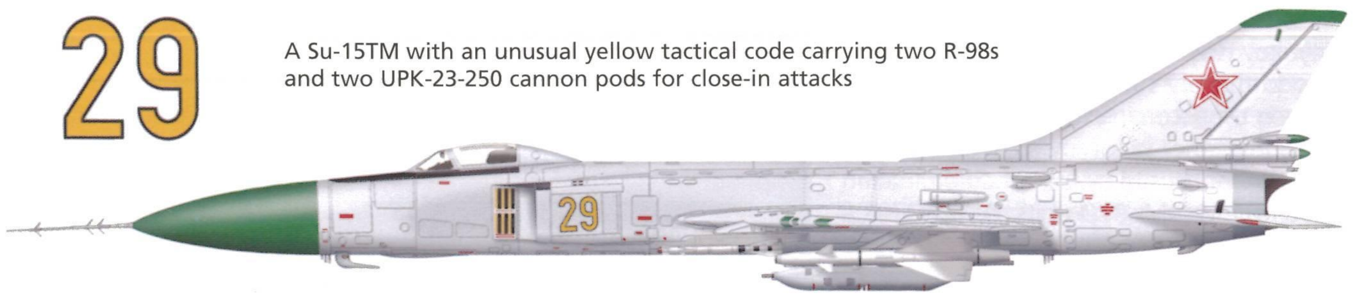
Capt. Aivazyan recalled: *'We took off at 0843 hrs, climbing to 6,000 m [19,685 ft]. The spyplane was above us – but where exactly? I kept turning my head, looking around, but saw no one. Then I noticed an explosion and five specks falling earthwards. Darn, I wish I had guessed this was the U-2 falling apart! Believing the explosion was a missile that had self-destructed, I realised that the SAM units had already opened fire and reported this to the control centre.'*

Skirting Sverdlovsk from the east along the U-2's anticipated track, the MiG-19s circled and initiated a landing approach to Kol'tsovo's runway 08 from the west. First, they passed through the kill zone of the 57th Brigade's SAM Battalion 1 at Kosoolino, which had to

Another publicity shot of a Su-15TM pilot receiving a last-minute briefing; the cranked-delta wings are clearly visible. The use of two boarding ladders at once was anything but standard operational procedure.

Su-15T '85 Red'; only 20 such aircraft were built

Su-15TM '06 Blue' with two R-98 AAMs; note the non-standard version of the Sukhoi OKB's 'winged archer' badge



A Su-15TM with an unusual yellow tactical code carrying two R-98s and two UPK-23-250 cannon pods for close-in attacks

Su-15TM '08 Red' operated by a Guards unit and sporting the appropriate (albeit a bit crude) badge

Su-15TM '11 Yellow' was apparently operated by the same unit as '29 Yellow' pictured above

Su-15TM '65 Blue' wearing the 'Excellent aircraft' badge; unusually, the black/yellow striped air intake warning stencils are missing

Su-15TM '61 Blue' with two R-98s and two UPK-23-250 pods; this tactical code typeface was common for the *Flagon*

wait until they were clear before taking a shot at the U-2. (It should be noted that the U-2 began disintegrating after the first hit, the debris cluttering the radarscopes and creating the false impression that the target was releasing chaff.) Passing near Pervo'ural'sk, the pair entered the kill zone of the 57th Brigade's SAM Battalion 4 at Staryye Ryoshety commanded by Maj. Shugayev. As the MiG-19s showed up on the radarscope, an excited guidance officer mistook them for more 'bogeys' and gave order to fire. It is possible that the IFF system was unserviceable or the wrong codes had been entered into the fighters' transponders. Anyway, three missiles were launched in quick succession at 0921 hrs; Safronov's MiG-19 took a direct hit over Revda, crashing fatally in a wooded area in the town of Degtyarsk further southeast; fortunately there were no further fatalities on the ground. (According to one account of the incident, Aivazyan spotted the incoming missile and went into a vertical dive, evading the missile; his wingman had no time to follow suit. Another account says that Aivazyan had a tendency to show off – which, for once, saved his life. Hearing on the radio that the U-2 had been destroyed, he began a spectacular dive, just for fun, causing the missile to lose target lock-on.) As the destruction of the intruder was reported all the way 'upstairs' to the Soviet leader Nikita S. Khruschchov, who was watching the May Day parade in Moscow's Red Square, the remains of Safronov's MiG-19

A three-view of a typical Su-15TM; note the location of the anti-glare panels

Su-15TM '43 Red' sporting the 'Excellent aircraft' badge, 393rd GvIAP, Privolzhskiy AB, Astrakhan'

Su-15UM '98 Red'; unusually, the entire boundary layer splitter plates are painted yellow on this aircraft

were still burning gently. The pilot was later awarded the Order of the Red Banner posthumously.

Despite the unimpressive initial results (which played into the hands of the 'missile lobby' supported by the head of state Nikita S. Khrushchov), these events demonstrated the need for a high-altitude interceptor. Actually, the fact that the existing interceptors had proved unable to reach Powers and it took a surface-to-air missile to blast him out of the sky was one of the reasons that made the Soviet 'fighter makers' work harder to develop more capable aircraft in order to 'stay in the business'.

Stratojet down!

Even though President Dwight D. Eisenhower had pledged to end US overflights of the Soviet Union, the international scandal triggered by the Powers shootdown did not put the Americans off PARPRO missions for long. Exactly two months later, on 1st June 1960, a Boeing-built ERB-47H-1-BW Stratojet ELINT aircraft (53-4281, c/n 4501305) of the 55th SRW/343rd SRS (some sources say 38th SRS) departed its temporary base at RAF Brize Norton, Oxfordshire, on a reconnaissance mission. The crew of six comprised aircraft captain Maj. Willard 'Bill' Palm, co-pilot/gunner Capt. Freeman Bruce Olmstead, navigator Capt. John McKone and three mission equipment operators (known in USAF slang as 'Ravens'): Maj. Eugene Posa, Capt. Dean Phillips and Capt. Oscar Goforth. For the latter, this was his first operational mission – and his last, as it turned out.

After heading northward over international waters for a while the aircraft turned east, flying over the Barents Sea past Norway and towards Soviet shores, approximately 80 km (50 miles) from the Kola Peninsula. When the Stratojet crossed the northern border of the USSR off Murmansk, a MiG-19 of the PVO Aviation's 171st GvIAP on QRA duty piloted by Capt. Vasiliy A. Polyakov scrambled from Murmansk to intercept the intruder, catching up with it near Cape Svyatoy Nos ('Holy Nose'). According to the American crew's reports, the MiG initially shadowed the ERB-47 at a distance, flying a parallel course, then crossed the Stratojet's track about three miles behind it, took up position about 12 m (40 ft)

Su-15TM '44 Blue' in non-standard blue camouflage applied locally

This Su-15TM belonging to the 54th GvIAP at Vaïnode had the Combat Red Banner Order and the Guards badge superimposed on the Sukhoi OKB badge

off the bomber's right wing and rocked its wings as a 'follow me' signal. As the spyplane ignored the signal and started a turn to the left as planned, flying at 9,140 m (30,000 ft) and 786 km/h (488 mph), Polyakov received the order to fire. His first burst of cannon fire raked the port wing, Nos. 1-3 engines and fuselage. As Capt. Olmstead returned fire, the ERB-47 flicked into a spin from which the pilots were able to recover; but then Polyakov finished off the target with a second salvo. At 1803 hrs Moscow time the uncontrollable Stratojet plunged into the Barents Sea, killing four of the six crew; the pilots and the navigator ejected but Maj. Palm apparently died of exposure in the frigid water. Olmstead and McKone were able to use their life rafts and were picked up by a Soviet fishing vessel more than six hours later, being taken into custody when the ship docked.

Ten days later Nikita S. Khrushchov announced *urbi et orbi* that the American spyplane had been shot down and two of the crewmembers captured, and that they would now face trial. Shortly after the inauguration of the new US President John F. Kennedy, high-level Soviet-US talks began, and Khrushchov offered to free Olmstead and McKone quickly – on condition that the announcements of the airmen's release is made simultaneously in Washington and Moscow, with no advance news leaks; the US publicly declares that it has discontinued U-2

Su-15TMs '07 Red' and '21 Yellow' as seen by the crews of the western reconnaissance aircraft they escorted away from the Soviet border.

Su-15TM '26 Red' maintains a close interest in a US Navy Lockheed P-3 Orion.

flights over Soviet territory; and the US promises not to draw 'international political dividends' out of the prisoners' release. After seven months of imprisonment and interrogations, the airmen were released on 25th January 1961 without being brought to trial. Palm's remains had been recovered by the Soviets and returned to the US on 25th July 1960; Posa's remains were likewise recovered, but never returned. Of course, the Americans maintained they were 'many miles away from the Soviet Sea frontier at all times'. (Note: Each crewmember was advanced one rank after this incident as indicated above.)

On 24th September 1962 another ELINT-configured 55th SRW Stratojet, this time an RB-47E captained by John E. Drost, was intercepted over the Baltic Sea by a MiG-19. No details are known.

Iran and Turkey: the 'hot' border

Before the overthrow of Iranian Shahinshah Mohammed Reza Pehlevi in 1979, relations between the USA and Iran were very friendly and both were united in their antagonism towards the Soviet Union. One result of this situation was that Imperial Iranian Air Force (IIAF) aircraft, often with CIA personnel on board, patrolled the border with the USSR and 'accidentally' strayed into Soviet territory for reconnaissance purposes and also to test the reaction of the Soviet defences. Hence the Soviet-Iranian stretch of the border was one area where incursions were quite frequent.

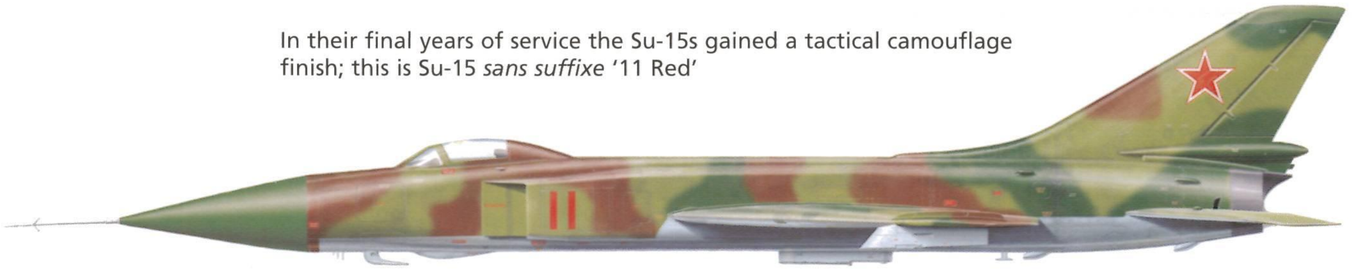
Thus, in the summer of 1963 an Aero Commander 560 light aircraft entered Soviet airspace from Iran. Two MiG-17Ps of the 12th Independent PVO Air Army/17th IAD commanded by Col. A. D. Kotov scrambled to intercept it. Having located the intruder, the MiG pilots, Capt. Stepanov and Lt. (SG) Soodarikov, signalled it to land at their home base; however, the aircraft pressed on towards the border in a determined attempt to escape. Stepanov had to open fire, damaging the Aero Commander, which crashed in flames in Iranian territory 1 km (0.62 miles) beyond the border. It was later established that an Iranian intelligence officer and a US Army colonel were among those killed in the crash. The incident occurred at a singularly inappropriate moment when a Soviet delegation headed by Leonid I. Brezhnev (who became the new Soviet leader in 1964) was making a friendly visit to Iran; apparently it had been *timed* to coincide with the visit!

In the summer of 1964 another Iranian Aero Commander 560 crossed the Soviet border near Serekhs. Once again a flight of 156th IAP MiG-17Ps led by Capt. Pechonkin scrambled to intercept it. This time the intruder was forced to land on one of the reserve airfields near Maryy and the crew was captured. Later, it was handed over to the Iranian authorities; the fate of the aircraft is not known.

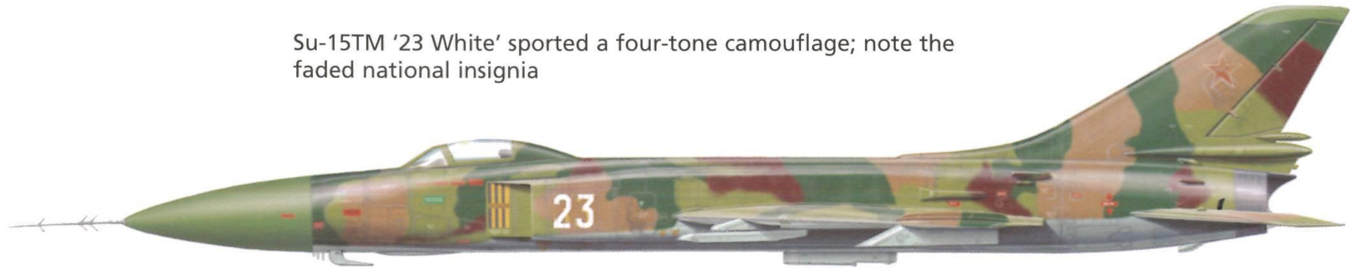
Here, again, we'll let Col.-Gen. (Retd.) Yuriy V. Votintsev tell the story:

'In 1960-61 the [Turkestan Independent PVO] Corps was bolstered ahead of schedule with 5,000 officers and some 20,000 enlisted men and took delivery of 100-plus S-75 SAM systems, a considerable number of new radars, including a dozen P-14s – the most sophisticated [Soviet AD] radar at the time. The 41st Radar Regiment commanded by D. N. Solodchenko had the greatest success in

In their final years of service the Su-15s gained a tactical camouflage finish; this is Su-15 *sans suffixe* '11 Red'

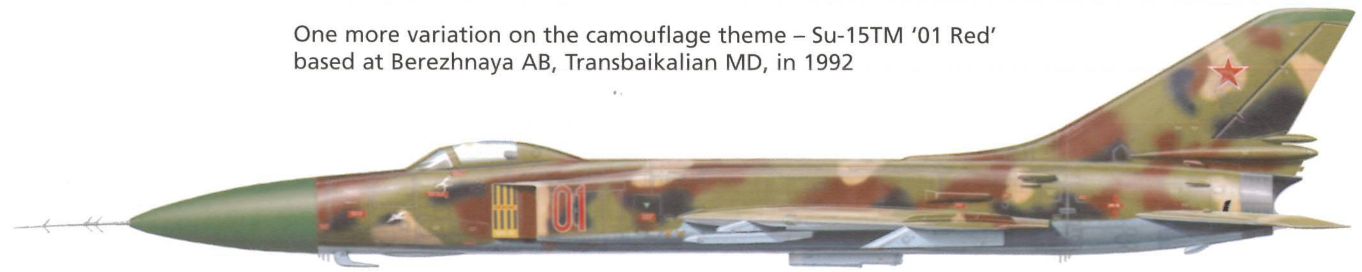


Su-15TM '23 White' sported a four-tone camouflage; note the faded national insignia



'23 Red' is a different *Flagon-F* wearing an altogether different camouflage scheme

One more variation on the camouflage theme – Su-15TM '01 Red' based at Berezhnaya AB, Transbaikalian MD, in 1992



Camouflaged Su-15TM '12 Yellow' armed with R-98 AAMs and UPK-23-250 cannon pods was photographed from a Royal Swedish Air Force fighter over international waters in the Baltic Sea.

Su-15UM '30 Blue' is seen immediately after becoming airborne. Note the extended periscope in the instructor's cockpit.

Opposite: Su-15TM '21 Blue' shines golden in the light of the setting sun.

The same aircraft banks away from the camera ship over thick overcast into which the sun has already vanished.

Su-15TM '29 Yellow' seen from the spyplane being intercepted.

mastering these stationary radars. The corps' two existing fighter regiments were augmented by four more, whereupon the corps was redesignated as the 30th Independent PVO Corps. Within a short time we had to establish eleven SAM brigades and two regiments, convert them to new hardware and have them undertake live weapons training at a practice range. Also, we had to reform and bolster the radar troops. Much attention was given to flight training and the provision of acceptable living and working conditions in the fighter units. The situation was further complicated by the motley aircraft fleet which included such types as the MiG-15, MiG-17, MiG-19, Yak-25, Yak-28P and Su-9.

In May 1963 the corps was expanded to become the 12th Independent PVO Army. Still, the reinforcement of the air defences at the Soviet Union's southern frontier did not put our neighbours off the idea of making provocative overflights of our territory. In the

One more view of Su-15TM '21 Blue' silhouetted against the evening sky.

Su-15TMs on the flight line. The rear end of a VZ-20/350-131 air/nitrogen charger vehicle on a ZiL-131 chassis is visible beside '61 Blue', which has the avionics bay cover removed.

summer of 1963 Leonid I. Brezhnev paid a visit to Iran. Just as he was delivering a speech at the Majlis (the National Consultative Assembly of Iran – *Auth.*), *a reconnaissance aircraft made an incursion into Soviet airspace. The QRA flight of the 156th IAP (flight leader Stepanov and wingman Soodarikov) intercepted it and shot it down. Still, the intruder made it across the border, crashing at Mominabad 30 km [18.6 miles] inside Iranian territory. A memo stating that Soviet pilots had just shot down an Iranian civil aircraft over Iranian territory was immediately circulated among the delegates of the Majlis. The Shahinshah asked Brezhnev to pause until the circumstances of the shootdown had been clarified. Immediately it came to light that the Iranian aircraft had headed towards the Soviet border and the flight had been performed without a flight plan or authorisation by the civil aviation authorities. The Shahinshah apologised for the interruption and Brezhnev carried on with his speech. This is when I got my second penalty from the Minister of Defence. The experience is not one that I like to recall; the then C-in-C of the PVO, [Air Marshal] Vladimir A. Soodets, took a biased point of view at the Military Council's session in*

The tower of a PVO fighter unit in the 1980s. The second man from right is the ATC shift supervisor.

Moscow, demanding that Stepanov and Soodarikov be court-martialled. I said that in this case I would have to submit my resignation (as Commander of the 12th Independent PVO Army – *Auth.*) *and face court-martial along with the pilots, since it was me who had ordered the intruder shot down. I also said that such a precedent, should it be created, would make the combat pilots fearful of repercussions for carrying out battle orders without reservations. The Military Council had to agree with my point. On the way back from Iran Leonid I. Brezhnev made a stopover in Tashkent. I was among the officials greeting him at the airport, as was [Army General] Ivan I. Fedyuninskiy, Commander of the [Turkestan] Military District. Taking us apart, Brezhnev said: "Our relations with Iran are beginning to improve. Therefore, Comrades, I ask you to be careful with your actions on the border."*

We took the request literally. Exactly a year later an identical Condor aircraft (*sic*; Votintsev means the Aero Commander – *Auth.*) *intruded into Soviet airspace and was intercepted by flight commander I. Zhuravlyov. This time the Iranian crew immediately "raised their hands" when confronted by the fighter and complied with the latter's commands, following it to a landing at an airfield near Maryy. When asked why they had not attempted to escape across the border, as their predecessors had done, the Iranian airmen said: "You would have killed us at once..."*

The investigation led by PVO Aviation Chief of Staff Lt.-Gen. I. P. Bashilov revealed that in both cases the flights had been officially performed for the Iranian-US Geographic and Mapping Company. However, the large amount of reconnaissance equipment aboard the aircraft and the fact that the crew had received special training, coached by American instructors, showed clearly that the aircraft were in fact operated by the CIA. During the intercept the fighters were guided by 17th PVO Division Commander A. D. Kotov, 156th IAP CO P. Ye. Koozin and 12th Radar Brigade CO L. B. Goshchinskiy. All my previous penalties were cancelled, and the actions of my subordinates were cited as a model for the Air Defence Force.'

A fine study of a pair of Su-15TMs ('11 Blue' and '21 Blue') over the Russian countryside.

The Su-9 and Su-11 saw a good deal of action, intercepting real-life targets. Thus in the late 1960s a pair of 976th IAP Su-9s scrambled from Kyurdamir AB, Azerbaijan, to intercept a pair of Imperial Iranian Air Force fighters that had entered Soviet airspace. Receiving authorisation from ground control, the flight leader fired a missile at the Iranians but the fighter's TsD-30 radar mistook the two intruders flying in close formation for a single large aircraft and placed the missile dead centre; the missile passed between the two fighters without hitting either of them.

Far more often, however, the *Fishpot* pilots had to deal with drifting reconnaissance balloons. In fact, a special version of the R-8M AAM with a larger warhead was developed for destroying these targets, since a standard missile was usually not enough to destroy the large balloon. For instance, in 1969 Ye. N. Kravets, a Su-9 pilot with the 179th GvIAP at Krasnovodsk, Turkmenia, fired RS-2-US AAMs at a reconnaissance balloon but succeeded only in shooting off the lower half of the extremely long sensor pack 'sausage' dangling under the balloon, so another fighter from a different unit had to be called in to finish it off ('eat up the sausage'). In an uncanny replay of this incident, in 1976 the same pilot (now flying a Su-11) again failed to destroy a reconnaissance balloon completely even with a special 'balloon killer' missile, annihilating only the lower half of the sensor pack.

An enamel badge of the National Air Defence Force portraying both fighters, SAMs and AD radars.

On 17th November 1970 a US Air Force Boeing KC-135R 'Briar Patch' reconnaissance aircraft captained by James W. Jones was intercepted by Soviet MiG-17s while conducted a SIGINT flight over international waters near Vaygach Island located in the Kara Sea between the Soviet mainland and Novaya Zemlya Island. One of the MiG-17s fired warning shots, but the KC-135R ignored them and continued on its mission. The MiGs continued to escort the spyplane, but did not fire on it again.

A version of the same badge with slightly different colours.

To give credit where credit is due, of all fighter types operated by the PVO the Su-15 probably had the highest percentage of successful real-life intercepts of aircraft intruding into Soviet airspace. Its baptism of fire came on 11th September 1970... well, actually the expression 'baptism of fire' is not really applicable because no shots were fired on this occasion. At 0336 hrs Moscow time PVO radar pickets near Sevastopol', the Ukraine, detected a lone aircraft heading north towards the Soviet border at 3,000 m (9,840 ft), and a 'Red Alert' was called. The target was then 260 km (160 miles) south-west of the city; when it approached within 100 km (62 miles) of the border, a 62nd IAP Su-15 scrambled

A Su-15TM coded '11 Blue' peels off, banking away from the camera ship. The empty pylons show this to be a practice flight.

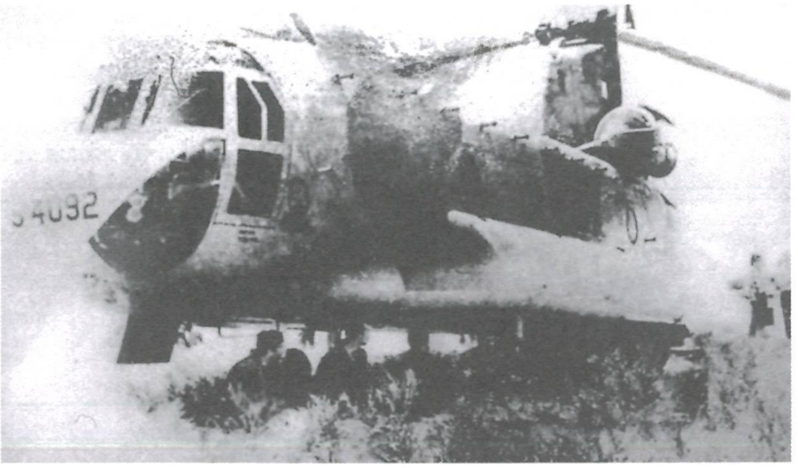
from Bel'bek AB to prevent an incursion. The target turned out to be an elderly Douglas C-47 belonging to the Hellenic Air Force, and when it eventually crossed the border the fighter lined up alongside and rocked its wings in the internationally recognised 'follow me' signal. The Dakota complied, landing at Bel'bek AB. It turned out that the Greek pilot, Lt. M. Maniatakis, had stolen the aircraft from Kania AB on the island of Crete and fled from his homeland where the fascist junta of the 'Black Colonels' had seized power. Maniatakis sought political asylum in the USSR, which was in all probability granted.

Throughout the 1970s the southern borders of the Soviet Union perpetually received the attentions of hostile aircraft coming from Turkey and Iran. The events described below are but a few of the incursions that took place there.

The end of the road: When the Su-15 was phased out, aircraft from various units operating the type were concentrated at a storage facility in Novosibirsk, including these camouflaged Su-15TMs.

Two more photos of Su-15TMs and Su-15UMs sitting in storage. Regrettably, most of them ended up as scrap metal, not as museum exhibits.

Su-15UM '46 Yellow' in the preservation compound at the 514th Aircraft Repair Plant in Rzhev together with Su-9 '05 Blue', MiG-23M '20 Red', MiG-29UB '80 Blue' and MiG-31 '24 Blue'.



Imperial Iranian Air Force CH-47C Chinook 5-4092 shot down by Capt. V. Shkinder on 21st July 1978.

On 21st October 1970 a USAF Beechcraft U-8 Seminole liaison aircraft straying into Soviet airspace was shot down over Armenia by MiG-17s. The crew of four survived and was rescued.

On 7th September 1972 a flight of Turkish Air Force (THK – *Türk Hava Kuvvetleri*) North American F-100 Super Sabres entered Soviet airspace near Leninakan, Armenia (the city is now called Gyumri). Despite flying at ultra-low altitude, the intruders were detected by AD radars in timely fashion. Another ploy of the 'bad guys' worked, however – the fighters flew in close formation, appearing on the radarscopes as one heavy aircraft (the USAF had used this tactic in Vietnam); hence only a single 166th IAP Su-15 scrambled from Sandar AB near Marneuli in neighbouring Georgia to intercept 'it'. The GCI command post operators did not realise that the target was not an 'it' but a 'they' until the Turkish fighters swept over the place with a roar.

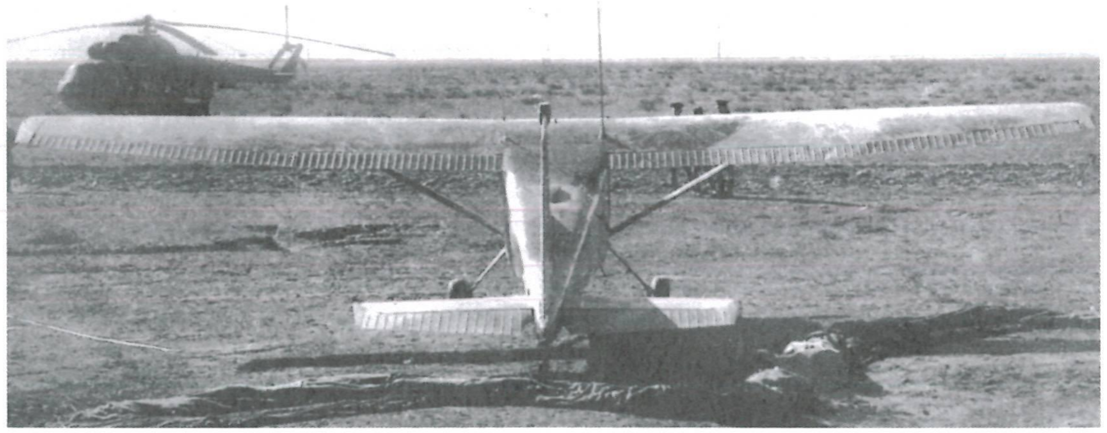
The lone Su-15 proved incapable of intercepting its quarry because its radar lacked 'look-down/shoot-down' capability. As a result, the F-100s flew over Leninakan and were fired upon by a heavy machine-gun crew providing anti-aircraft protection for the PVO's radar site but got away unscathed.

As mentioned earlier, on 21st June 1973 an Iranian Aero Commander 560 intruding into Soviet airspace near Baku was intercepted by Su-15s which compelled it to land at Nasosnaya AB.

On 23rd May 1974 another THK F-100 entered Soviet airspace over the Caucasus region with impunity. A 976th IAP Su-15 standing on QRA duty scrambled from Kyurdamir, Azerbaijan, but was not directed towards the target because the latter had unwisely intruded in an area defended by an SAM regiment. A missile was fired at the F-100 but missed due to a malfunction in the guidance system.

Eventually, however, the Turks fell victim to the rule 'pride goeth before the fall'. On 24th August 1976 Soviet AD radars detected a target moving in Turkish airspace towards the Soviet border. This was soon identified as a pair of F-100s flying in close formation. No fewer than three Su-15s scrambled this time (two 976th IAP aircraft from Kyurdamir and one 166th IAP aircraft from Sandar AB), but again they did not manage to get a piece of the action. Again, the fighters had rashly flown right into a nest of SAMs; this time the PVO crews on the ground did their job well and one of the Super Sabres was shot down. Unfortunately the wreckage fell on the wrong side of the border and the pilot, who ejected, also landed in Turkish territory; the following day the Turks raised hell, accusing the Soviet Union of the 'wanton destruction of a Turkish fighter'.

A while earlier, on 2nd April 1976, a 777th IAP Su-15 flown by Lt. (SG) P. S. Strizhak scrambled from Sokol AB on Sakhalin Island to intercept a USAF Boeing RC-135 reconnaissance aircraft which had entered the 100-km territorial waters strip. Shortly after take-off the pilot was redirected towards a new target – a Japanese Maritime Self-Defence



An IIAF de Havilland Canada DHC-2 (L-20) Beaver sits where it had been forced to land by 156th IAP fighters on 28th June 1967, with a Soviet Border Guard Mi-8T in the background.

Force (JMSDF) Lockheed-Kawasaki P2V Neptune reconnaissance aircraft flying over the Sea of Japan at 2,000 m (6,560 ft) off the southern tip of Sakhalin. Approaching within 5-6 km (3.1-3.7 miles) of the target, the interceptor followed it, flying a parallel course. Apparently Strizhak flipped the wrong switch and inadvertently fired an R-98R missile at the Neptune, though no order to attack had been given. Realising his mistake, the pilot made a turn just in time, breaking target lock-on; the missile passed off the spyplane's starboard wing and self-destructed harmlessly.

Drifting reconnaissance balloons launched in large numbers from Western Europe continued to be a major nuisance for the Soviet air defences. Most PVO units, including those equipped with Yak-28Ps, had to deal with them from time to time; the 174th GvIAP at Monchegorsk (Murmansk Region) alone destroyed three such balloons in the mid-1970s. Non-inflatable intruders were also common in those days, as NATO reconnaissance aircraft often prowled along the Soviet borders. Yak-28Ps, especially those based up north, often scrambled to intercept them but no cases when either side fired in anger are known. The Yak pilots were up against such varied types as the Lockheed SR-71A Blackbird, Lockheed P-3 Orion and Martin RB-57.

On one occasion, however, such an interception resulted in a small duel. A *Firebar* operated by a Leningrad PVO District unit intercepted a McDonnell Douglas F-4 Phantom II (most probably a Luftwaffe F-4F or RF-4E) over the Baltic Sea. A fierce game of tag ensued, the fighters circling in full afterburner and pulling such G forces that the tinted-glass visors on the Yak pilots' ZSh-3 helmets slid closed all by themselves. In the middle of the action another Yak-28P appeared on the scene and joined the fray; finding himself outnumbered, the Phantom pilot resorted to vertical manoeuvres. The opponents were manoeuvring so vigorously that eventually they lost sight of each other and had to head for their respective bases after hitting 'bingo fuel'.

Apart from NATO spyplanes, the 174th GvIAP was regularly checked up on by Finnish Air Force Il'yushin IL-28R *Beagle* reconnaissance aircraft. (Finland was on good terms with the Soviet Union and bought military equipment from the East and West alike, but that did not stop the Finns from performing reconnaissance!) The Finnish pilots put the *Beagle's* long endurance to good use and sometimes got real cheeky. The IL-28R would approach the border and be detected by AD radars, whereupon the interceptor on QRA duty would pop up and say hello. Both aircraft would fly along the border for a while; then the *Beagle* would turn and ostensibly head for home. The Soviet interceptor was by then low on fuel and unable to loiter near the border, so it would return to base – and the spyplane would come back. Another Yak-28P would scramble to intercept... here we go again; sometimes three *Firebar* crews would consecutively ward off the same aircraft!

Once again, the only known instance when the Yak-28P fired in anger was against its own side – but this time a real traitor was involved. A civil aviation pilot (formerly an Air Force pilot who had been discharged for the good of the force) hijacked an Aeroflot Soviet Airlines Antonov An-2 *Colt* utility biplane at Tuapse, Georgia, and headed for Turkey. Since the defector was a former military pilot who could disclose classified information to the West and there was no one else aboard the aircraft, the PVO commanders ordered the An-2 shot down to stop the traitor from escaping.

A 171st IAP *Firebar* piloted by Capt. Parfilov scrambled from Gudauta, accompanied by a MiG-17 flown by the unit's deputy CO Lt.-Col. V. N. Prishchepa to act as a communications relay aircraft. Parfilov quickly located the target, but then problems began. The Yak was carrying the usual complement of two R-8 missiles, one semi-active radar homing and one IR-homing. The R-8R SARH version could not be used because the An-2 was flying only 10-15 m (33-50 ft) over the sea to stay below radar cover and the water was giving false radar returns, preventing a stable lock-on. The K-8T heat-seeking version was also useless, since the piston-engined biplane had a very small IR signature.

After several unsuccessful attempts Parfilov finally reported a good lock-on and fired the R-8R; however, the missile lost lock-on and went ballistic, exploding far behind the An-2 which was by then over international waters. *'There's nothing more I can do here'*, Parfilov radioed, in clear. The PVO command centre then ordered the fighters to switch roles: the Yak would act as a communications relay aircraft while the MiG would attack, using its cannons to do the job. This time the attack was successful (alas for an innocent An-2).

On 21st July 1978 at 0621 hrs, four Iranian Boeing Vertol CH-47C Chinook helicopters were spotted by Soviet air defence radars.

Capt. Ghennadiy N. Yeliseyev who lost his life while destroying an intruding Iranian aircraft a ramming attack on 28th November 1973.

When Capt. A. V. Dem'yanov of the 152nd IAP, who took off in a MiG-23M to intercept them, managed to find only a helicopter which he identified as 'friendly', ground control disagreed and ordered Capt. V. Shkinder to scramble and intercept. Shkinder located two of the Chinooks and attacked them after receiving appropriate orders. The first helicopter was destroyed by two R-60 missiles, with the loss of eight lives, and the second (IIAF serial 5-4092) crash-landed in Soviet territory after being hit by cannon fire; the crew of four was detained by a Soviet Border Guards patrol. The remaining two Chinooks escaped back into Iranian airspace. This was the first time a Soviet combat aircraft (be it PVO or Air Force) had shot down a helicopter. Later, the Soviet authorities allowed an IIAF tech staff to come and repair the Chinook, whereupon the flight crew was released and flew the chopper back home. Capt. Shkinder was decorated and transferred to another location to avoid reprisals.

At 1457 hrs Moscow time on 23rd December 1979 a Cessna 185 Skywagon light aircraft entered Soviet airspace 175 km (108 miles) south-west of Maryy, Turkmenia, coming from Iranian territory and flying at about 3,000 m (9,840 ft). The aircraft was detected by AD radars three minutes before it crossed the border, and a 156th IAP Su-15 took off almost immediately from Maryy-2 AB to intercept it. The pilot was guided towards the target by GCI stations but failed to spot it because the Cessna was wearing a camouflage colour scheme (so much for allegations about 'navigation errors'). The radars lost track of the target shortly afterwards and, after circling for a few minutes, the fighter pilot had no choice but to head for home. (Three more Su-15s and a MiG-23M had also scrambled by then, but they were not directed towards the target.) Nevertheless, his mission was accomplished; when (unbeknownst to the Soviet pilot) the interceptor passed directly above the Cessna, its pilots aborted their plan, losing altitude and opting for an emergency landing for fear of being shot down (hence the disappearance of the target from the radarscopes). Eventually they landed on a highway 195 km (121 miles) west of Maryy and were soon arrested by Soviet border troops.

Odd episodes

It wasn't always that Soviet interceptors stopped foreign aircraft from getting in; occasionally they found themselves in the role of intruders. Sometime in 1961 an embarrassing episode occurred; a disgruntled Su-9 pilot decided to 'go over the wall', crossing the Iranian border to land at Abadan. The aircraft was taken to the USA for evaluation and the defector received political asylum in the States.

Curious incidents also occurred from time to time. In the early 1970s a 393rd GvIAP Su-11 standing on QRA duty at Privolzhskiy AB near Astrakhan', southern Russia (and armed with live missiles, of course), scrambled to intercept a Su-9 acting as a practice target. In the course of a poorly organised intercept the Su-11 pilot fired a missile – and shot down his comrade-in-arms (who fortunately managed to eject and survived). A similar 'friendly fire' incident took place in 1969 in the 179th IAP (the 'non-Guards' one at Stryy AB). Maj. Koorilin on QRA duty was tasked with performing a practice intercept of a Su-9 from the same regiment. The pilot successfully located the target, got a good lock-on and, after receiving authorisation from the ground control centre (!), fired all four missiles. Realising what was about to happen, the aghast pilot pushed the stick forward, putting the aircraft's nose down and breaking the lock-on; the semi-active radar homing missiles followed the radar beam, diving away from the target and self-destructing.

On another occasion a young MiG-25P pilot serving with the 445th IAP at Kotlas in the High North got so carried away while chasing the target during a practice sortie that, neglecting to watch the artificial horizon, he put the aircraft into a 90° bank. The radar locked onto the ground and the machine dived earthwards in full afterburner, quickly exceeding the speed limit. Realising this, the pilot yanked the control stick sharply to initiate a recovery – and blacked out as the fighter pulled 12 Gs (!). Regaining consciousness a while later, he saw the target on his radarscope and fired a missile, completing his mission as planned. The aircraft was bent quite badly, yet it had stayed in one piece.

A practice mission involving live missile launches by a MiG-25P at a target range near Astrakhan' nearly ended in disaster; an R-40T missile failed to part company with the pylon as the rocket motor ignited, causing strong yaw. The pilot, who was his unit's deputy CO, did his best to counter the yaw during the motor's eight-second burn time – guessing all the while whether the missile would self-destruct after burnout and blow the aircraft to pieces. Luckily there was no explosion.

As a last resort...

Earlier in this chapter, mention has been made of a might-have-been ramming attack in the style of the Second World War. Occasionally, however, Soviet PVO pilots actually did perform this extremely risky type of attack on jet fighters when all else failed.

The Soviet Air Force/Tactical Aviation fighter regiments flying the MiG-21 received a capability boost when they converted to the MiG-21S and, especially, the MiG-21SM; the latter version boasted a built-in twin-barrel 23-mm cannon in addition to the two heat-seeking AAMs. However, pilots converting to the MiG-21SM were prone to forgetting about the cannon because the MiG-21PF/MiG-21PFM and MiG-21S lacked it (the bulky GP-9 gun pod was seldom carried). This led to a unique event in the MiG-21's peacetime career, which took place in the autumn of 1973 in the skies over Soviet Transcaucasia.

On 28th November 1973 a 982nd IAP MiG-21SM coded '02 Blue' and piloted by Deputy Squadron Commander Capt. Ghennady N. Yeliseyev, who was on QRA duty at Vaziani AB in Georgia, scrambled to intercept an Iranian aircraft that had intruded into Soviet airspace near Mugan Valley (Azerbaijan). Oddly, to this day there is no reliable information as to the type of the intruder; different sources state such varied types as the

Capt. Valentin A. Kulyapin who destroyed an intruding Canadair CL-44 by ramming it on 18th July 1981.

McDonnell Douglas F-4D Phantom II, Lockheed T-33A Shooting Star, an unspecified light aircraft or even the Lockheed C-130 Hercules, concurring only in that it was an IIAF machine.

Yeliseyev caught up with the target when it was very close to the border. After receiving orders to fire he tried launching his R-3 AAMs, but the first one missed and the second one refused to leave the launch rail. Time was running out and the regimental command post ordered the intruder destroyed at all costs. It is possible that in the heat of the moment Yeliseyev forgot that his aircraft had a built-in cannon (ironically, it was the regiment's only fighter with the integral cannon). Hence he took the fateful decision to ram the Iranian. At 1315 hrs the Soviet fighter hit the intruder's tail unit with its wing. Both aircraft went down in a shower of debris. Yeliseyev was killed, and the intruder's crew (according to one report, an Iranian trainee and a US instructor pilot) survived. For his heroism Capt. Yeliseyev was posthumously awarded the HSU title on 14th December 1973.

Another incident on the Iranian border occurred on 17th-18th July 1981. This time, for once, the intruder was not a reconnaissance aircraft but a gun-runner. Shortly after the outbreak of the Iran-Iraq War the Iranians made a deal to smuggle weapons – officially 'pharmaceuticals' – from Israel (the latter was co-operating with the USA in the infamous 'Iran-Contra affair'). In late June a Canadair CL-44D4-6 freighter registered LV-JTN (c/n 34)

The unit badge of the 116th TsBP training centre in Astrakhan', showing a golden eagle clutching a La-17 target drone. The motto reads: 'Discretion, instant reaction, the will to win'.

was chartered for this purpose from the Argentinean airline Transporte Aéreo Rioplatense by one Stuart Allen McCafferty, a Scots businessman acting as intermediary between the Iranians and the Swiss arms dealer Andreas Jenni. On 17th July the freighter's captain decided to take a short cut across Soviet airspace en route from Tel Aviv to Tehran in order to skirt the north flank of the Iran-Iraq front. Flying at about 8,000 m (26,250 ft), the aircraft briefly entered Soviet airspace over Armenia but then left it, and the Soviet PVO command post in the area took no

A simplified version of the 116th TsBP badge as applied to the centre's aircraft.

action. (Another account says that the pair of 166th IAP Su-15s which had taken off to intercept was ordered back to base when the CL-44 escaped to Iran.)

The following day the crew again took the same route on the return flight. This time two pairs of Su-15s scrambled from Vaziani AB near Tbilisi, Georgia, to intercept; however, the indecision and bungled actions of the duty officers at the 34th VA's command post meant that the interceptors were unable to find the target and were forced to return after hitting 'bingo fuel'. Eventually a single 166th GvIAP Su-15 flown by Capt. Valentin A. Kulyapin and armed with two R-98 medium-range AAMs was vectored towards the intruder with orders to force it down at a Soviet airfield. The fighter pilot gave the customary 'follow me' signals, but the big turboprop ignored them and started manoeuvring dangerously, determined to get away. Due to poor interaction between the pilot and the command centre the pursuit continued for more than ten minutes; eventually Kulyapin received orders to destroy the intruder. Since the target was too close for missile launch and could escape across the border before the fighter could move away to a safe distance, Kulyapin opted for a ramming attack. Moving into line astern formation, the Su-15 pitched up into a climb, slicing off the CL-44's starboard tailplane with its fin and fuselage. The freighter plummeted to the ground 2-3 km (1.24-1.86 miles) from the border, killing the three-man crew (captain Hector Cordero, first officer Jose Burgueño and flight engineer Hermete Boasso) and Stuart McCafferty, who was also aboard. Kulyapin's aircraft was seriously damaged by the collision and the pilot ejected, landing safely not far from the crash site. This time the wreckage fell on Soviet territory, furnishing irrefutable evidence of a border violation. For this performance Capt. Kulyapin was awarded the Order of the Red Banner.

Order of battle

As of 1970 the PVO Aviation was organised into two PVO Districts, which had eight PVO Armies, 16 air corps and 24 air divisions. Additionally, the PVO Aviation included direct reporting units – four combat training centres (including the 148th TsBP i PLS), two pilot colleges and one technical staff college. All in all, the PVO Aviation comprised 81 fighter regiments. Furthermore, it included 17 support air regiments (training, research and transport regiments) and a number of independent air squadrons and air detachments. In addition to the pilot and tech staff colleges, the Air Force Academy and training units, personnel training took place at the practice ranges near Astrakhan' where live weapons training took place. The Ashuluk range catered for the SAM crews, while the range next to Privolzhskoye AB served the fighter units.

The following is the PVO Aviation orbat as of early 1970. For the sake of simplicity the units' awards have been omitted.

A few words about the units' honorary appellations. *Zabai**kal'**skiy* means Transbaikalian. The appellation *Ter**nopo**l'skiy* was given for taking the Ukrainian town of Tarnopol' (later renamed Ternopol') during the

PVO Aviation order of battle as of 1st January 1970

Unit	Base	Aircraft types
Direct reporting units		
978th OTAP	Klin-5 AB, Moscow Region	Transports
67th OAE DRLO	Sialuliai, Lithuania	Tu-126
148th TsBP i PLS, Savasleyka AB		
592nd UIAP	Klin-5 AB	Su-15
594th UIAP	Savasleyka AB	Su-15, Yak-28P
615th UIAP	Savasleyka AB	MiG-25
...th OTAE	Savasleyka AB	Transports
18th TsBP, Krasnovodsk, Turkmenia		
Not known if air units were included		
116th TsBP, Astrakhan'		
Not known if air units were included		
234th UTsBP, Priozyorsk and Sary-Shagan		
60th SIAD		
678th *Zabaikal'skiy* GvISAP	Priozyorsk-6 AB	Tu-16, MiG-21PF/MiG-21PFM
679th ITAP	Priozyorsk-6 AB	An-2, An-8, An-12, Mi-4, Mi-6
Armavir Red Banner VVAUL		
627th *Ternopol'skiy* GvUAP	Sal'yany AB	?
709th UAP	Maikop, Stavropol' Territory	?
713th UAP	Armavir, Krasnodar Territory	?
761st *Polotskiy* UAP	Adjikabul', nr Baku, Azerbaijan	Aero L-29 Delfin
Stavropol' VVAULSh		
208th UAP	Sal'sk, Rostov Region	Su-9, Su-15, MiG-17
382nd UAP	Khankala AB, Groznyy, Chechen-Ingush ASSR	Aero L-29 Delfin
700th UAP	Tikhoretsk, Krasnodar Territory	MiG-17F, MiG-17PF, UTI-MiG-15
762nd UAP	Kholodnogorsk, Stavropol' Territory	?
Daugavpils PVO Engineering College, Lithuania		
Not known if air units were included		
Moscow PVO District (HQ Moscow)		
436th OTAP	Stoopino-6 AB, Moscow Region	?
2nd PVO Corps, HQ Rzhev (Kalinin Region) [1]		
23rd IAP	Rzhev	Su-9
28th IAP	Krichev, Mogilyov Region, Belorussia	Su-9
28th *Leningradskiy* GvIAP	Andreapol', Kalinin Region	Su-15
401st IAP	Smolensk	MiG-19P/MiG-19PM (?)
790th IAP	Khotilovo AB, Bologoye, Kalinin Region	Su-11
3rd PVO Corps, HQ Yaroslavl'		
415th IAP	Yaroslavl'-Toonoshna AP	Su-9
445th IAP	Arkhangel'sk-Talagi AP	Tu-128
611th IAP	Dorokhovo AB, Bezhetsk, Kalinin Region	Su-15
7th PVO Corps, HQ Bryansk		
191st IAP	Yefremov, Tula Region	Su-11
472nd IAP	Kursk-Khalino AP	MiG-19P/MiG-19PM (?)

16th PVO Corps, HQ Bryansk		
153rd IAP	Morshansk, Tambov Region	Su-15
786th IAP	Pravdinsk, Kaliningrad Region	MiG-19P/MiG-19PM (?)
Baku PVO District (HQ Baku, Azerbaijan)		
12th PVO Corps, HQ Rostov-on-Don, Russia		
83rd GvIAP	Rostov-on-Don	MiG-19P/MiG-19PM (?)
14th PVO Corps, HQ Tbilisi, Georgia		
359th OTAE	Sandar AB, nr Tbilisi	
166th GvIAP	Marneuli AB, nr Sandar	MiG-17
167th *Starokonstantinovskiy* GvIAP	Kopitnari AB, nr Kutaisi, Georgia	Su-9
171st *Tool'skiy* IAP	Bombora AB, nr Gudauta, Georgia	Yak-28P
15th PVO Corps, HQ Alyaty, Azerbaijan		
82nd IAP	Nasosnaya AB, nr Baku	Yak-28P
976th *Insterburgskiy* IAP	Kyurdamir, central Azerbaijan	Su-9
10th Red Banner PVO Division, HQ Volgograd, Russia		
562nd IAP	Krymsk, Krasnodar Territory	MiG-17PF (?)
16th Guards PVO Division, HQ Krasnovodsk, Turkmenia		
179th *Transil'vanskiy* GvIAP	Krasnovodsk	Su-9
364th IAP	Nebit-Dag, Turkmenia	MiG-17PF (?)
393rd *Baranovichskiy* GvIAP	Privolzhskiy AB, Astrakhan' Region, Russia	Su-11
2nd Independent PVO Army (HQ Minsk, Belorussia)		
... OTAE	Machoolishchi AB, Minsk	?
11th PVO Corps, HQ Baranovichi, Belorussia		
61st IAP	Baranovichi	Su-9
201st IAP	Machoolishchi AB, Minsk	Su-9
27th PVO Corps, HQ Riga, Latvia		
54th *Kerchenskiy* GvIAP	Vaïnode, Latvia	Su-15
372nd IAP	Lotsiki AB, nr Daugavpils, Latvia	Yak-28P
2nd PVO Division, HQ Kaliningrad, Russia		
689th *Sandomirskiy* GvIAP	Neevenskoye AB, Kaliningrad Region	MiG-19PM (?)
4th Independent PVO Army (HQ Sverdlovsk)		
128th (or 142nd?) OTAE	Sverdlovsk-Kol'tsovo AP	?
19th PVO Corps, HQ Chelyabinsk		
412th IAP	Dombarovskiy, Orenburg Region	Su-9
763rd IAP	Komsomol'skiy, Khanty-Mansi Autonomous District, Tyumen' Region	Yak-28P
20th PVO Corps, HQ Perm'		
54th OTAE	Perm'-Bol'shoye Savino AP	?
764th IAP	Perm'-Bol'shoye Savino AP	MiG-19PM (?)
765th IAP	Salka, nr Nizhniy Tagil, Sverdlovsk Region	Su-9
28th PVO Division, HQ Kuibyshev		
1411th OTAE	Kryazh AB, Kuibyshev Region	?
681st IAP	Danilovo AB, nr Yoshkar-Ola, Marii ASSR	Su-15
683rd IAP	Bobrovka AB, Kuibyshev Region	Su-9

6th Independent PVO Army (HQ Leningrad)		
54th Guards PVO Corps, HQ Taitsy (Leningrad Region)		
57th GvIAP	Veshchevo AB, nr Vyborg, Leningrad Region	Su-9
177th IAP	Lodeynoye Pol'e, Leningrad Region	Su-9
180th *Volgogradskiy* GvIAP	Gromovo AB, nr Solov'yovka, Leningrad Region	Yak-25M
14th PVO Division, HQ Tallinn, Estonia		
425th IAP	Haapsalu AB, Estonia	MiG-19PM (?)
655th IAP	Pärnu, Estonia	Yak-28P
656th IAP	Tapa AB, Estonia	Su-9
8th Independent PVO Army (HQ Kiev, the Ukraine)		
223rd OTAP	Kiev-Zhulyany AP	?
28th PVO Corps, HQ L'vov, the Ukraine		
179th *Yaroslavskiy* IAP	Stryy, L'vov Region	Su-9
894th IAP	Ozyornoye AB, Zhitomir, Zhitomir Region	Su-9
1st PVO Division, HQ Sevastopol', the Ukraine		
62nd IAP	Bel'bek AB, Sevatopol', Crimea Region	Su-15
9th PVO Division, HQ Donetsk, the Ukraine		
636th IAP	Kramatorsk, Donetsk Region	MiG-17PF (?)
11th PVO Division, HQ Dnepropetrovsk, the Ukraine		
16th OTAE	Dnepropetrovsk	
738th IAP	Mokraya AB, Zaporozhye	Yak-28P
933rd IAP	Kaïdaki AB, nr Dnepropetrovsk	MiG-19P/MiG-19PM (?)
19th PVO Division, HQ Vasil'kov, Kiev Region, the Ukraine		
146th GvIAP	Vasil'kov	MiG-19P/MiG-19PM (?)
21st PVO Division, HQ Odessa, the Ukraine		
90th IAP	Chervonoglinskaya AB, Artsiz, Odessa Region	Su-15
136th IAP	Kirovskoye AB, Crimea Region	Su-9
10th Independent PVO Army (HQ Arkhangel'sk)		
359th OTAP	Arkhangel'sk-Vas'kovo AP	?
21st PVO Corps, HQ Severomorsk, Murmansk Region		
174th *Pechengskiy* IAP	Monchegorsk, Murmansk Region	Yak-28P
431st IAP	Afrikanda, Murmansk Region	MiG-19PM (?)
941st IAP	Kilp-Yavr AB, Murmansk Region	Su-9
4th PVO Division, Novaya Zemlya Island		
317th OTAE	Rogachovo AB, Novaya Zemlya	?
72nd *Polotskiy* GvIAP	Amderma, Nenets Autonomous District	Tu-128
991st IAP	Rogachovo AB, Novaya Zemlya	MiG-17PF (?)
5th PVO Division, HQ Petrozavodsk, Republic of Karelia, Russia		
265th IAP	Poduzhem'ye, nr Kem', Karelia	Su-15
641st *Vilenskiy* GvIAP	Petrozavodsk-Besovets AP	Yak-28P
23rd PVO Division, HQ Vas'kovo, Arkhangel'sk		
125th OTAE	Arkhangel'sk-Vas'kovo AP	?
518th *Berlinskiy* IAP	Arkhangel'sk-Talagi AP	Tu-128
524th IAP	Letneozyorsk AB, Arkhangel'sk Region	Yak-28P

11th Independent PVO Army (HQ Khabarovsk)		
8th PVO Corps, HQ Komsomol'sk-on-Amur		
41st IAP	Postovaya AB, nr Sovetskaya Gavan', Khabarovsk Territory	MiG-17PF (?)
60th IAP	Komsomol'sk-on-Amur/Dzyomgi	Su-15
302nd IAP	Pereyaslavka-2 AB, Khabarovsk Territory	Su-15
23rd PVO Corps, HQ Vladivostok, Primor'ye Territory		
22nd GvIAP	Tsentral'naya-Ooglovaya AB, Artyom, nr Vladivostok	Su-9, Yak-25M
47th IAP	Zolotaya Dolina, nr Nakhodka, Primor'ye Territory	Su-9
530th IAP	Chugooyevka AB, Primor'ye Territory	MiG-17PF (?)
821st IAP	Spassk-Dal'niy, Primor'ye Territory	Yak-28P
6th PVO Division, HQ Petropavlovsk-Kamchatskiy		
865th GvIAP	Petropavlovsk-Kamchatskiy/Yelizovo AP	Su-9
24th PVO Division, Sakhalin Island		
328th OTAE	Sokol AB, Sakhalin	?
308th IAP	Boorevesnik AB, Iturup Island, the Kuriles	MiG-17PF (?)
528th IAP	Smirnykh AB, Sakhalin	Yak-28P
777th IAP	Sokol AB, Sakhalin	Su-15
25th PVO Division, HQ Oogol'nyye Kopi, Anadyr'		
120th (or 252nd?) OTAE	Oogol'nyye Kopi AB (aka Anadyr'-Oogol'nyy AP)	?
529th GvIAP	Oogol'nyye Kopi AB	Yak-28P
29th *Amurskaya* PVO Division, HQ Belogorsk, Amur Region		
301st GvIAP	Kalinka (Desyatyy Oochastok) AB, Khabarovsk Territory	Su-9
12th Independent PVO Army (HQ Tashkent, Uzbekistan)		
7th PVO Division, HQ Alma-Ata, Kazakhstan		
9th *Odesskiy* GvIAP	Andizhan, Uzbekistan	Su-15
737th IAP	Sary-Shagan AB, nr Karaganda, Kazakhstan	Su-9
15th PVO Division, HQ Samarkand, Uzbekistan		
735th IAP	Khanabad AB, Karshi, Uzbekistan	Su-9
17th PVO Division, HQ Maryy, Turkmenia		
152nd GvIAP	Ak-Tepe AB, nr Ashkhabad, Turkmenia	MiG-19P/MiG-19PM (?)
156th *El'bingskiy* GvIAP	Maryy-2 AB	Su-9, Yak-28P
14th Independent PVO Army (HQ Novosibirsk)		
43rd OTAE	Novosibirsk-Tolmachovo AP	?
20th PVO Division, HQ Tolmachovo		
50th OTAE	Bratsk, Irkutsk Region	?
712th *Chernovitskiy* IAP	Kansk, Krasnoyarsk Territory	MiG-17PF (?)
849th IAP	Koopino AB, Novosibirsk Region	Su-9
26th PVO Division, HQ Irkutsk		
126th OTAE	Belaya AB, Irkutsk Region	?
22nd *Khalkhingol'skiy* IAP	Bezrechnaya AB, Chita Region	MiG-17PF (?)
350th IAP	Belaya AB, Irkutsk Region	Tu-128

33rd PVO Division, HQ Semipalatinsk, Kazakhstan		
126th OTAE	Belaya AB, Irkutsk Region	?
64th IAP	Omsk-Severnyy AP, Omsk Region, Russia	Tu-128
356th IAP	Zhana-Semey AB, Semipalatinsk	Tu-128

Note: OTAP = *ot**del'**nyy **trahns**portnyy **a**via**polk*** – independent airlift regiment; OTAE = *ot**del'**nyaya **trahns**portnyaya **a**viaeska**dril'**ya* – independent airlift squadron; OAE DRLO = *ot**del'**nyaya **a**viaeska**dril'**ya **dahl'**nevo **rah**diolokatsi**on**novo obnaru**zhe**niya* – independent AWACS squadron; SIAD = ***smesh**annaya istre**bit**el'naya **a**viadi**vee**ziya* – composite fighter division; GvISAP = *Gvar**dey**skiy in**strook**torskiy **smesh**annyy **a**via**polk*** – Guards instructional composite air regiment; ITAP = *in**strook**torskiy **trahns**portnyy **a**via**polk*** – Guards instructional airlift regiment; VVAUL = ***Vys**sheye vo**yen**noye aviatsi**on**noye oo**chil**ishche **lyot**chikov* – military pilot college; VVAULSh = ***Vys**sheye vo**yen**noye aviatsi**on**noye oo**chil**ishche **lyot**chikov i **shtoor**manov* – military pilot and navigator college.

1. Now Tver' Region

Great Patriotic War. The appellation ***Pol**otskiy* was given for the liberation of the Belorussian city of Polotsk. The appellation *Lenin**grad**skiy* was given for the unit's part in the defence of Leningrad. The 445th IAP was named after the Lenin Young Communist League (Komsomol).

The appellation ***Sta**rokonstan**tin**ovskiy* was given for the liberation of the Ukrainian city of Starokonstantinov. The appellation ***Tool'**skiy* was given for the defence of the Russian city of Tula. The appellation ***In**sterburgskiy* was given for taking Insterburg Castle in what is now the Kaliningrad Region. The appellation *Transil'**van**skiy* was given for the unit's part in the battles in Transilvania, Romania, at the end of the war. The appellation *Bara**no**vichskiy* was given for liberating the Belorussian city of Baranovichi. The appellation ***Ker**chenskiy* was given for the liberation of Kerch, a seaport in the Crimea. The appellation *Sando**mir**skiy* was given for liberating the Polish city of Sandomierz. The appellation *Volgo**grad**skiy* was given for the unit's part in the defence of what was then Stalingrad (now Volgograd).

The appellation *Yaro**slav**skiy* was given for liberating the Russian city of Yaroslavl'. The appellation ***Pech**engskiy* was given for liberating the city of Pechenga on the Kola Peninsula. The appellation ***Vil**enskiy* was given for liberating the city of Vil'no (subsequently known as Vilnius), Lithuania. The appellation *Ber**lin**skiy* was given for the unit's part in taking Berlin. The appellation ***Odes**skiy* was given for liberating the Ukrainian seaport of Odessa. The appellation ***El'**bingskiy* was given for liberating the Polish city of Elbląg (previously known by its German name of Elbing). The appellation *Cherno**vits**kiy* was given for liberating the Ukrainian city of Chernovtsy. The appellation *Khalkhin**gol'**skiy* was given for the unit's part in the war with Japan on the Khalkhin Gol River, Manchuria, in 1939.

By 1975 the order of battle was almost unchanged, except that the 641st GvIAP and the 991st IAP had switched bases. Several units had completed their transition to the Su-15 (the 166th IAP, the 976th IAP, the 364th IAP, the 57th IAP, the 156th IAP and the 22nd IAP) or Su-15TM (the 171st IAP, the 54th GvIAP, the 681st IAP, the 180th GvIAP, the 636th IAP, the 431st IAP, the 941st IAP, the 265th IAP, the 991st IAP, the 47th IAP, the 865th IAP and the 712th IAP), and the MiG-25P was being fielded with the 445th IAP, the 786th IAP, the 83rd GvIAP, the 61st IAP, the 764th IAP, the 146th GvIAP and the 530th IAP, replacing older types. At this point the PVO Aviation had 16 regiments of Su-15s *sans suffixe*, 12 regiments of Su-15TMs, three Su-11 regiments, 19 Su-9 regiments, seven MiG-25P regiments, six MiG-19 regiments, two MiG-17 regiments, 12 Yak-28P regiments and five Tu-128 regiments. The total fighter fleet was around 3,200.

Sometime after 1970 the 27th PVO Corps headquartered in Riga also came to include the 892nd GvIAP at Neevenskoye operating Yak-28Ps. However, in the first six months of 1976 the unit disbanded, and its assets were used to form an independent fighter squadron established pursuant to the PVO Aviation Commander's order dated 1st June 1976. The squadron's 12 to 14 *Firebars* redeployed to Bezrechnaya AB near Chita; the latter already hosted the 123rd OAE equipped with elderly MiG-17s, which reported to the 26th PVO Division and guarded the nearby Telemba target range. Thus, the personnel and hardware of the 123rd OAE were replaced by the newcomers, and in August 1976 the squadron commenced combat duty on the Yak-28P.

By the end of 1979 the orbat had changed; the PVO Aviation included 14 Su-15/Su-15T regiments, nine regiments and one squadron of Su-15TMs, three Su-11 regiments, eight Su-9 regiments, ten MiG-25P regiments, six MiG-19 regiments, one MiG-17PF regiment, one MiG-21*bis* regiment, nine MiG-23M regiments, one MiG-23ML regiment, one MiG-23P regiment, eight Yak-28P/Yak-28PM regiments and five Tu-128 regiments.

PVO Aviation order of battle as of 1st January 1980 (prior to the MoD order dated 5th January 1980) (combat units only)

Unit	Base	Aircraft types
Moscow PVO District (HQ Moscow)		
2nd PVO Corps, HQ Rzhev (Kalinin Region)		
23rd IAP	Rzhev	Su-9
28th IAP	Krichev, Mogilyov Region, Belorussia	Su-9
28th *Leningradskiy* GvIAP	Andreapol', Kalinin Region	Su-15
401st IAP	Smolensk	MiG-23M
790th IAP	Khotilovo AB, Bologoye, Kalinin Region	Su-11
3rd PVO Corps, HQ Yaroslavl'		
415th IAP	Yaroslavl'-Toonoshna AP	Su-9
445th IAP	Kotlas, Murmansk Region	MiG-25P
611th IAP	Dorokhovo AB, Bezhetsk, Kalinin Region	Su-15
7th PVO Corps, HQ Bryansk		
191st IAP	Yefremov, Tula Region	Su-11
472nd IAP	Kursk-Khalino AP	MiG-23P
16th PVO Corps, HQ Gor'kiy		
153rd IAP	Morshansk, Tambov Region	Su-15
786th IAP	Pravdinsk, Kaliningrad Region	MiG-25P
Baku PVO District (HQ Baku, Azerbaijan)		
12th PVO Corps, HQ Rostov-on-Don, Russia		
83rd GvIAP	Rostov-on-Don	MiG-25P
14th PVO Corps, HQ Tbilisi, Georgia		
166th GvIAP	Marneuli AB, nr Sandar, Georgia	Su-15
171st *Tool'skiy* IAP	Bombora AB, nr Gudauta, Georgia	Su-15TM
15th PVO Corps, HQ Alyaty, Azerbaijan		
82nd IAP	Nasosnaya AB, nr Baku	MiG-25P
976th *Insterburgskiy* IAP	Kyurdamir, central Azerbaijan	Su-15
10th Red Banner PVO Division, HQ Volgograd, Russia		
562nd IAP	Krymsk, Krasnodar Territory	Yak-28P
16th Guards PVO Division, HQ Krasnovodsk, Turkmenia		
179th *Transil'vanskiy* GvIAP	Nebit-Dag, Turkmenia	MiG-23M
393rd *Baranovichskiy* GvIAP	Privolzhskiy AB, Astrakhan' Region, Russia	Su-11
2nd Independent PVO Army (HQ Minsk, Belorussia)		
11th PVO Corps, HQ Baranovichi, Belorussia		
61st IAP	Baranovichi	MiG-25P
201st IAP	Machoolishchi AB, Minsk	MiG-23ML
2nd PVO Division, HQ Kaliningrad, Russia		
689th *Sandomirskiy* GvIAP	Neevenskoye AB, Kaliningrad Region	MiG-23M
4th Independent PVO Army (HQ Sverdlovsk)		
19th PVO Corps, HQ Chelyabinsk		
412th IAP	Dombarovskiy, Orenburg Region	MiG-23M
763rd IAP	Komsomol'skiy, Khanty-Mansi Autonomous District, Tyumen' Region	Yak-28P
20th PVO Corps, HQ Perm'		
764th IAP	Perm'-Bol'shoye Savino AP	MiG-25P
765th IAP	Salka, nr Nizhniy Tagil, Sverdlovsk Region	Su-9
28th PVO Division, HQ Kuibyshev		
681st IAP	Danilovo AB, nr Yoshkar-Ola, Marii ASSR	Su-15
683rd IAP	Bobrovka AB, Kuibyshev Region	Su-9
6th Independent PVO Army (HQ Leningrad)		
54th Guards PVO Corps, HQ Taitsy (nr Gatchina, Leningrad Region)		
177th IAP	Lodeynoye Pol'e, Leningrad Region	Su-9
180th *Volgogradskiy* GvIAP	Gromovo AB, nr Solov'yovka, Leningrad Region	Su-15TM
8th Independent PVO Army (HQ Kiev, the Ukraine)		
1st PVO Division, HQ Sevastopol', the Ukraine		
62nd IAP	Bel'bek AB, Sevatopol', Crimea Region	Su-15
9th PVO Division, HQ Donetsk, the Ukraine		
636th IAP	Kramatorsk, Donetsk Region	Su-15TM
11th PVO Division, HQ Dnepropetrovsk, the Ukraine		
738th IAP	Mokraya AB, Zaporozhye	Yak-28P
933rd IAP	Kaïdaki AB, nr Dnepropetrovsk	MiG-25P
19th PVO Division, HQ Vasil'kov, Kiev Region, the Ukraine		
146th GvIAP	Vasil'kov	MiG-25P
21st PVO Division, HQ Odessa, the Ukraine		
90th IAP	Chervonoglinskaya AB, Artsiz, Odessa Region	Su-15
10th Independent PVO Army (HQ Arkhangel'sk)		
21st PVO Corps, HQ Severomorsk, Murmansk Region		
174th *Pechengskiy* IAP	Monchegorsk, Murmansk Region	Yak-28P
431st IAP	Afrikanda, Murmansk Region	Su-15TM
941st IAP	Kilp-Yavr AB, Murmansk Region	MiG-23M
4th PVO Division, Novaya Zemlya Island		
72nd *Polotskiy* GvIAP	Amderma, Nenets Autonomous District	Tu-128/Tu-128M
641st *Vilenskiy* GvIAP	Rogachovo AB, Novaya Zemlya	Yak-28PM
5th PVO Division, HQ Petrozavodsk, Republic of Karelia, Russia		
265th IAP	Poduzhem'ye, nr Kem', Karelia	Su-15TM
57th GvIAP	Petrozavodsk-Besovets AP	Su-15TM
23rd PVO Division, HQ Vas'kovo, Arkhangel'sk		
518th *Berlinskiy* IAP	Arkhangel'sk-Talagi AP	Tu-128/Tu-128M
524th IAP	Letneozyorsk AB, Arkhangel'sk Region	MiG-25P

11th Independent PVO Army (HQ Khabarovsk)		
8th Red Banner PVO Corps, HQ Komsomol'sk-on-Amur		
41st IAP	Postovaya AB, nr Sovetskaya Gavan', Khabarovsk Territory	MiG-17PF (?)
60th IAP	Komsomol'sk-on-Amur/Dzyomgi	Su-15
302nd IAP	Pereyaslavka-2 AB, Khabarovsk Territory	Su-15
23rd PVO Corps, HQ Vladivostok, Primor'ye Territory		
22nd GvIAP	Tsentral'naya-Ooglovaya AB, Artyom, nr Vladivostok	MiG-23M
47th IAP	Zolotaya Dolina, nr Nakhodka, Primor'ye Territory	Su-15TM
530th IAP	Chugooyevka AB, Primor'ye Territory	MiG-25P
821st IAP	Spassk-Dal'niy, Primor'ye Territory	Yak-28P
6th PVO Division, HQ Petropavlovsk-Kamchatskiy		
865th GvIAP	Petropavlovsk-Kamchatskiy/Yelizovo AP	Su-15TM
24th PVO Division, Sakhalin Island		
308th IAP	Boorevesnik AB, Iturup Island, the Kuriles	MiG-21*bis*
528th IAP	Smirnykh AB, Sakhalin	Yak-28P
777th IAP	Sokol AB, Sakhalin	Su-15
25th PVO Division, HQ Oogol'nyye Kopi, Anadyr'		
529th GvIAP	Oogol'nyy Kopi (aka Anadyr'-Oogol'nyy AP)	Yak-28P
29th Amurskaya PVO Division, HQ Belogorsk, Amur Region		
301st GvIAP	Kalinka (Desyatyy Oochastok) AB, Khabarovsk Territory	MiG-23M
12th Independent PVO Army (HQ Tashkent, Uzbekistan)		
7th PVO Division, HQ Alma-Ata, Kazakhstan		
9th *Odesskiy* GvIAP	Andizhan, Uzbekistan	Su-15
737th IAP	Sary-Shagan AB, nr Karaganda, Kazakhstan	Su-9
15th PVO Division, HQ Samarkand, Uzbekistan		
735th IAP	Khanabad AB, Karshi, Uzbekistan	MiG-23M
17th PVO Division, HQ Maryy, Turkmenia		
152nd GvIAP	Ak-Tepe AB, nr Ashkhabad, Turkmenia	MiG-23M
156th *El'bingskiy* GvIAP	Maryy-2 AB	Su-15
14th Independent PVO Army (HQ Novosibirsk)		
20th PVO Division, HQ Tolmachovo		
712th *Chernovitskiy* IAP	Kansk, Krasnoyarsk Territory	Su-15TM
849th IAP	Koopino AB, Novosibirsk Region	Su-9
26th PVO Division, HQ Irkutsk		
22nd *Khalkhingol'skiy* IAP	Bezrechnaya AB, Chita Region	Su-15
350th IAP	Belaya AB, Irkutsk Region	Tu-128/Tu-128M
...th OIAE [1]	Bezrechnaya AB, Chita Region	Su-15TM
33rd PVO Division, HQ Semipalatinsk, Kazakhstan		
64th IAP	Omsk-Severnyy AP, Omsk Region, Russia	Tu-128/Tu-128M
356th IAP	Zhana-Semey AB, Semipalatinsk	Tu-128/Tu-128M

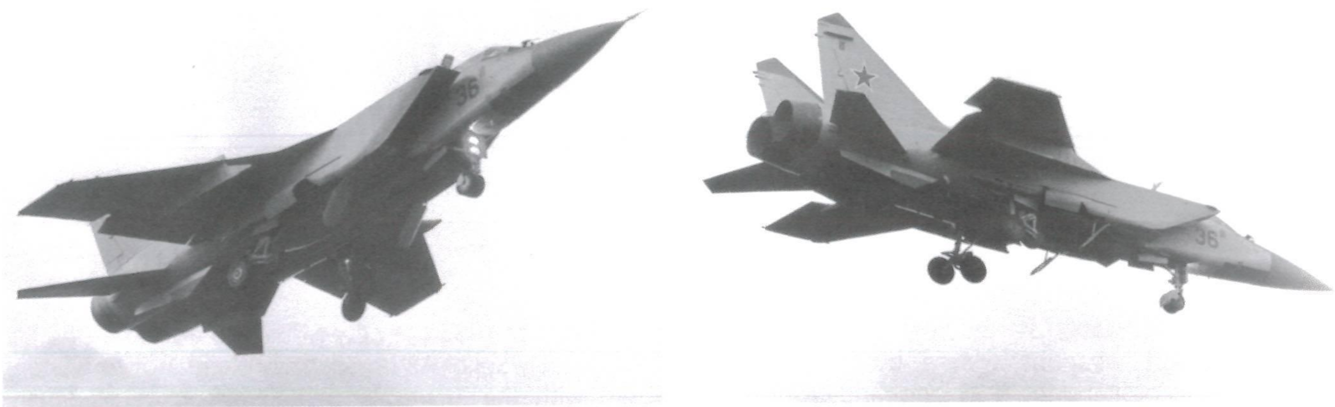
1 OIAE = *o*t*d*el'nyaya *i*stre*b*it*el'naya *a*viaeskad*ril'*ya – independent fighter squadron

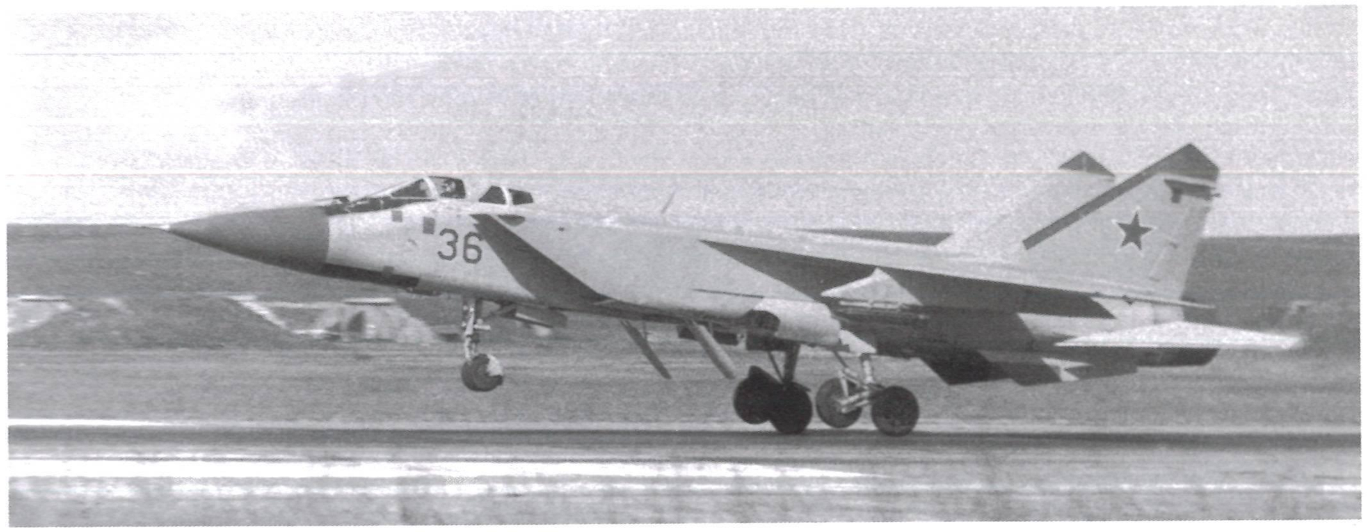
4 At the Close of the Soviet Era

In 1982 the PVO Aviation started fielding the new S-155 aerial intercept weapons system built around the MiG-31 interceptor and the R-33 long-range AAM. Even before the *Foxhound* had completed its state acceptance trials, several MiG-31s were delivered to a first-line PVO unit for evaluation. As production and deliveries built up, the MiG-31 supplanted first and foremost the Tu-128 and Tu-128M long-range interceptors. The fighter regiments stationed in the Moscow Air Defence Area, the High North and the Far East were the first to re-equip. The airmen of the 786th IAP stationed at Pravdinsk (the one located north of Gor'kiy, not the one in the Kaliningrad Region) and the 763rd IAP stationed at Komsomol'skiy AB (Khanty-Mansi Autonomous District, Tyumen' Region) led the way.

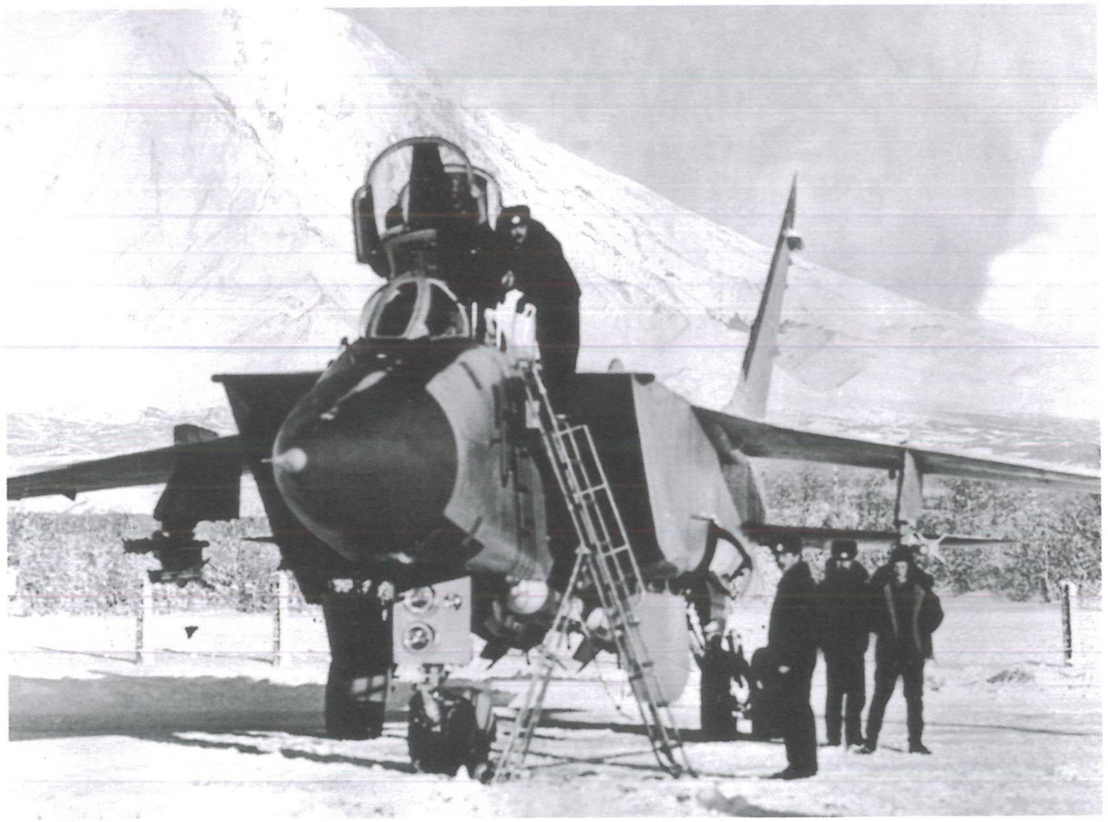
The aircrews of the 174th *Pechengskiy* Red Banner IAP stationed in Monchegorsk on the Kola Peninsula started their conversion training In January 1982. The regiment converted fully from the Yak-28P to the MiG-31 in 1983. In September 1983 the new MiGs also arrived in the Far East, namely Sokol AB on Sakhalin Island (not to be confused with the identically named airport in Magadan, which is much further up north). In the fighter units of the PVO Aviation the MiG-31 supplanted the Su-15TM and the Tu-128, which were getting long in the tooth. Gradually several other PVO Aviation fighter regiments re-equipped with the MiG-31. In the European part of the Soviet Union they were based at Amderma, Gromovo AB, Kotlas, Monchegorsk, Morshansk, Pravdinsk, Arkhangel'sk-Talagi airport and Khotilovo AB.

Thus the MiG-31 *sans suffixe* (and its upgraded MiG-31 (*izdeliye* 01DZ), MiG-31B and MiG-31BS variants) became one of the key aircraft types filling the air defence role in the final years of the Soviet Union's existence, along with the Su-27P interceptor and the A-50 AWACS. Still, the older Su-15TM, MiG-25PD/MiG-25PDS and MiG-23P interceptors and MiG-23ML/MiG-23MLD fighters served on with the PVO Aviation in considerable numbers because





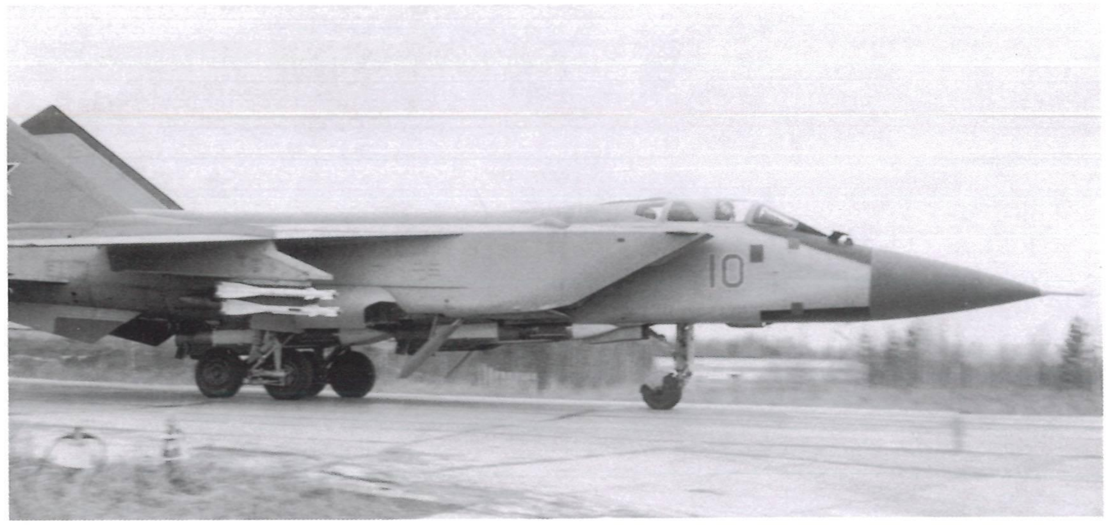
Three views of an IFR-capable MiG-31 coded '36' during a training flight.



Previous page: MiG-31B '72 Blue' operated by the 54th GvIAP takes off at Savasleyka AB.

With snow-covered mountains in the background, a MiG-31 is serviced at an airbase in the Far East. The aircraft is on QRA duty, carrying a full set of missiles.

MiG-31 '10 Blue' carries a full complement of four R-33 long-range AAMs under the belly and four R-60M short-range AAMs on APU-60-2 adapters under the wings.

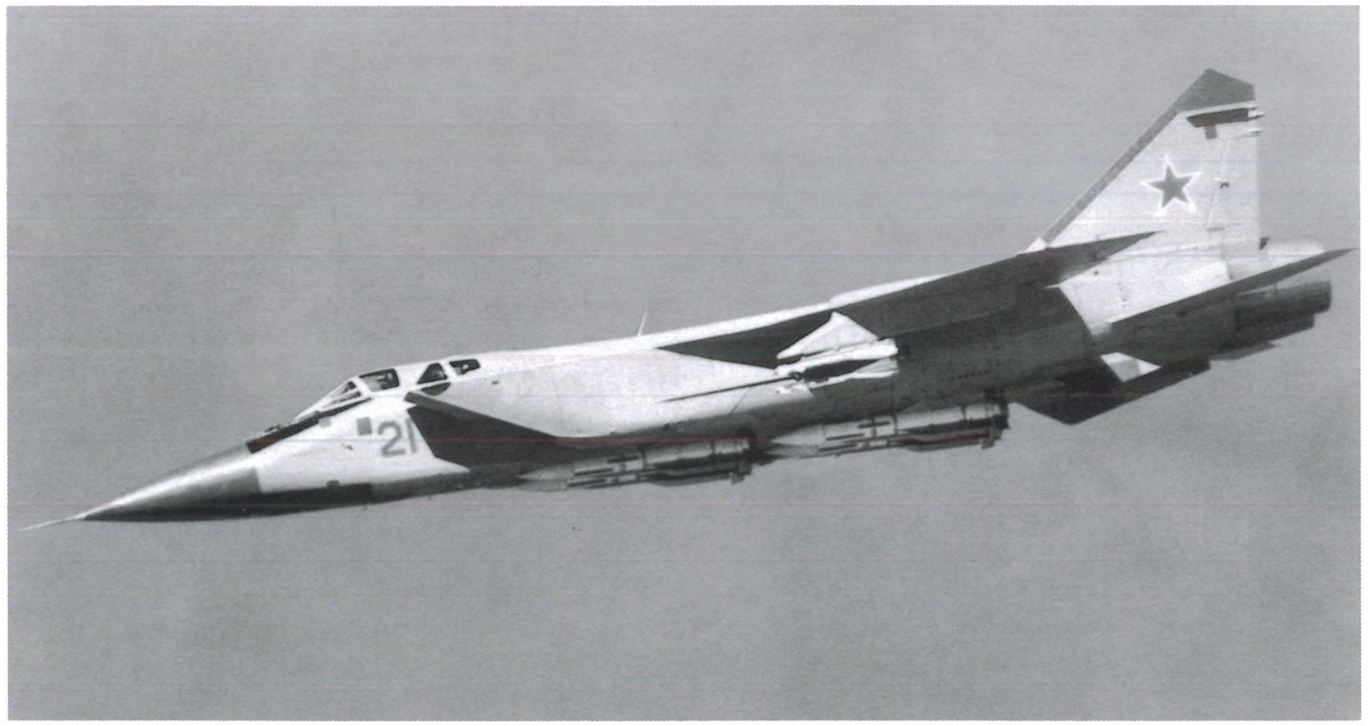


A pair of MiG-31s on the flight line. The *Foxhound*'s trademarks staggered-tandem main gear bogies are clearly visible.

'99 Blue', an early-model MiG-31 *sans suffixe* with no IFR capability.

One of the first photos of the MiG-31 published in the west.

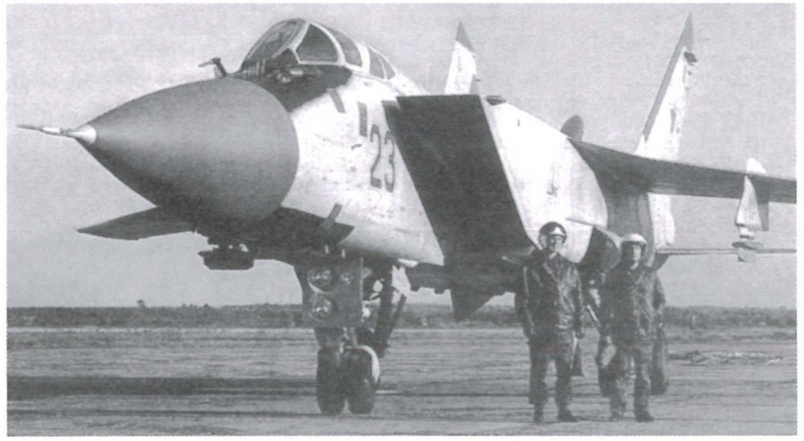
This view of the MiG-31 shows the front pair of R-33s is semi-recessed while the rear one is exposed.

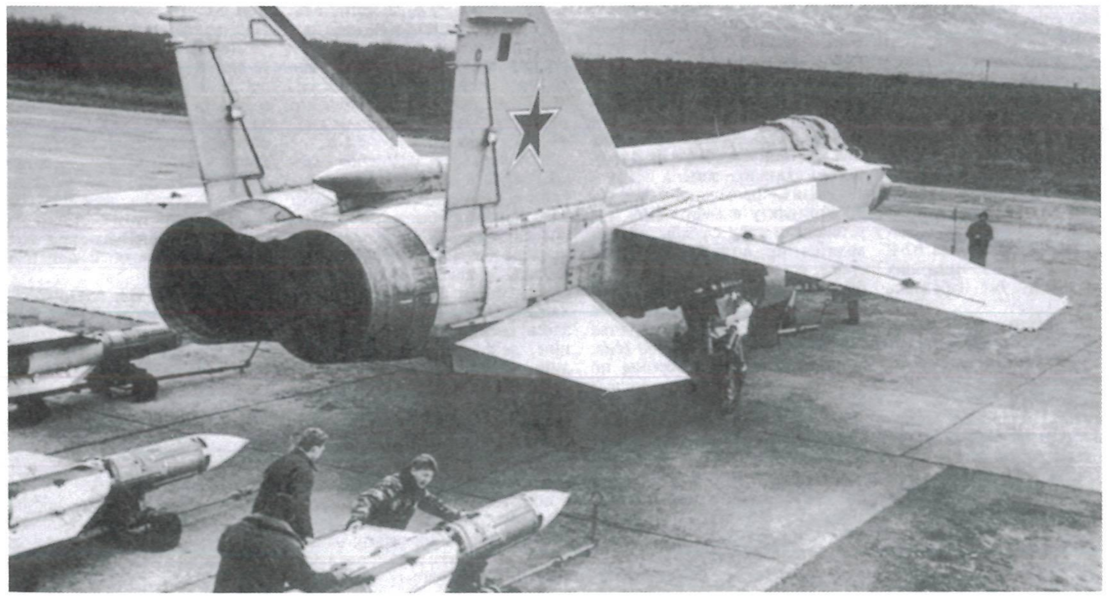


MiG-31 '01 Blue' parked in an earthen revetment. Note the curious curved shape of the intakes' inner lip.

PVO airmen pose with a MiG-31B that has recently returned from a sortie (note the open brake parachute housing.)

the re-equipment could not proceed fast enough, being limited by the Gor'kiy factory's MiG-31 production rate. Whereas Soviet interceptors had been capable of attaining speeds up to 3,000 km/h (1,863 mph) and altitudes in excess of 20,000 m (65,620 ft) since the late 1970s, an unrefuelled range of more than 4,000 km (2,485 miles) did not become possible until the 1980s. Also, the new missile and cannon armament of Soviet interceptors introduced in the 1980s allowed them to destroy targets within a wider range of speeds and altitudes, including terrain-following cruise missiles in an ECM environment.





Armourers prepare to hook up four R-33 missiles to a MiG-31.

Published in the mid-1980s by the *Tekhnika i Vo'oruzheniye* (Equipment and Armament) magazine, these were the first colour photos of the MiG-31 released in the USSR.

In 1980 the PVO Aviation's 148th TsBP i PLS at Savasleyka AB started getting to grips with the brand-new Su-27P. Col. I. Ye. Zhookov, Col. L. I. Linnik, Lt.-Col. E. V. Boogorskiy, Lt.-Col. V. V. Kroot'ko, Maj. V. Ye. Gladkiy and Maj. A. I. Naumov were the first pilots to master the *Flanker-B* and explore its combat capabilities. WSOs Capt. S. N. Baldin, Capt. L. A. Demidov, Capt. D. A. Dobrydneyev and Capt. M. V. Subbotin followed suit because they, too, had to be capable of flying the fighter. The Su-27P officially joined the inventory in 1984. First-line PVO Aviation units operating Su-15, Yak-28P and MiG-23 interceptors started converting to the type in 1985. Among the service pilots, Col. V. I. Nagornyy, Col. I. M. Maksimov and Maj.-Gen. O. V. Anisimov were the first to gain their *Flanker* type ratings.

The first operational unit to receive the Su-27P was the 60th IAP sharing the Komsomol'sk-on-Amur/Dzyomgi airfield with the manufacturer (KnAAPO). That same year the 941st IAP, a 10th Independent PVO Army unit stationed beyond the Arctic Circle (at Kilp-Yavr AB on the Kola Peninsula, not far from the Norwegian border), likewise began its transition to the Su-27. The first six machines arrived in late December; by the end of 1986 the unit had received 20 more *Flanker-Bs*. Conversion was certainly not made any easier by the fact that production Su-27UB two-seaters did not become available until 1986 and the pilots had to master the new hardware on their own, without an instructor in the back seat to give a helping hand.

The re-equipment proceeded at a brisk pace. At the end of 1986 the 562nd IAP of the 19th Independent PVO Army stationed at Krymskaya AB began conversion training for the Su-27. The unit received its first nine

Aptly coded '31 Blue', this probeless *Foxhound* sits in front of its hardened aircraft shelter at a Far Eastern airbase.

Wearing pressure suits and GSh-6A full-face pressure helmets, the crew of this MiG-31 exudes confidence and experience.

The volcanoes of Kamchatka form a picturesque backdrop for this MiG-31, with its usual weapons complement (four R-33 AAMs, four R-60M AAMs and ammunition for the cannon) arrayed in front.

Flankers during the second half of the year, followed by 16 more in the course of 1987. In 1987 the 641st *Vilenskiy* IAP awarded the Kutuzov Order, another 10th Independent PVO Army unit, started converting to the Su-27. This regiment was stationed at Rogachovo AB, the Soviet Union's northernmost airbase located on Novaya Zemlya (= New Land) Island. The unit's pilots made their first flights in the Su-27 in August 1987; the first nine single-seaters and a single Su-27UB were delivered to Rogachovo AB in early October, ten more aircraft following in the spring of 1988. In March 1988 the 641st IAP became operational at Nar'yan-Mar airport in the Arkhangel'sk Region; just over three months later the unit began flying sorties from its home base on Novaya Zemlya.

In late 1987 the first Su-27s arrived at Bombora AB in Gudauta, Georgia, on the Black Sea coast. Initially the resident 171st GvIAP of the 19th Independent PVO Army operated 14 *Flankers*; in the spring of 1988 this number increased to 26.

In the late 1980s the pilots of the PVO's two northernmost units, the 941st IAP and the 641st IAP, mastered operations from an *ad hoc* ice airstrip on Graham Bell Island which is part of the Zemlya Frantsa-Iosifa (Franz-Joseph Land) archipelago. This was a daunting task requiring excellent airmanship, and the airmen of both units stood up to the challenge.

In 1987-88 the Su-27 made its appearance in the Baltic republics, serving with the 54th *Kerchenskiy* Red Banner GvIAP of the 6th Independent PVO Army; the regiment was based at Vaïnode, Latvia. In 1989 it was the turn of the PVO's 689th *Sandomirskiy* GvIAP operating from Neevenskoye AB near Kaliningrad to re-equip with the *Flanker*. A dozen Su-27P interceptors arrived at Neevenskoye at the end of the year; 20 more followed in 1990. In the second half of that year 25 Su-27Ps were delivered to the 9th *Odesskiy* Red Banner GvIAP of the 12th Independent PVO Army; this regiment operating from Andizhan, Uzbekistan, was the Soviet PVO's sole Central Asian unit to operate the type.

The Air Defence Force's order of battle, too, underwent certain changes in the 1980s as a result of ill-founded and damaging 'experiments' initiated by the Chief of General Staff Marshal Nikolay V. Ogarkov. Between 1980 and 1985 eight PVO fighter regiments deployed in the borderside military districts were transformed into fighter-bomber regiments and placed under Air Force control; this unfortunate decision undoubtedly had a major detrimental

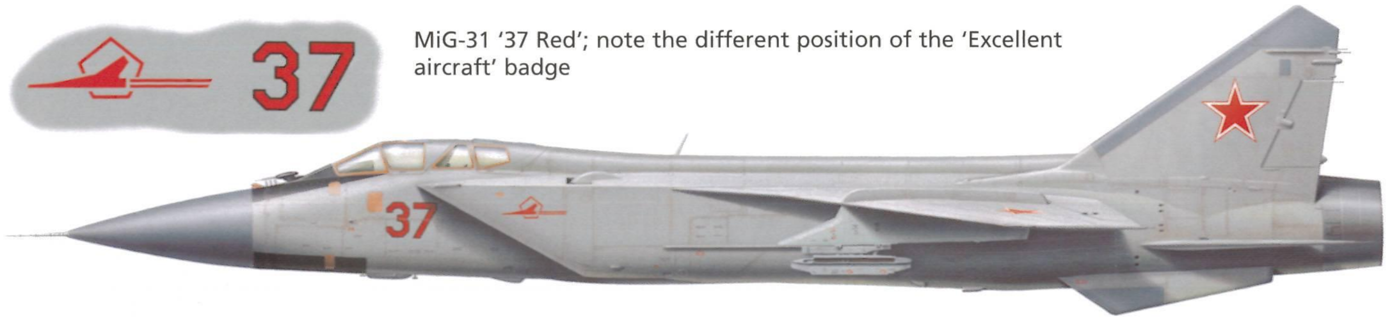
Eight R-60M short-range AAMs on a ground handling dolly.

MiG-31s sit in front of their shelters at a dispersal area. The HASs were usually arranged in groups of three.

MiG-31 '61 Blue' sporting three 'kill' stars and the 'Excellent aircraft' badge

25

MiG-31 '25 Blue' with APU-60-2 adapters



MiG-31 '37 Red'; note the different position of the 'Excellent aircraft' badge

05

MiG-31 '05 Red'

effect on the nation's first line of air defence. Also, the PVO flying personnel's proficiency level generally declined nationwide. In the course of five years the number of aerial intercept practice missions in automated GCI mode was reduced sixfold. Nevertheless, the skill level of the aircrews remained very high. Most of the PVO's fighter pilots were well prepared for conducting daytime group dogfights and night-time group action; many had the appropriate ratings for night landings on runways lacking runway lights and for daytime formation landings (in a pair).

In 1987 Maj.-Gen. Vladimir I. Andreyev was appointed the new PVO Aviation Commander. In 1990 he was superseded by Lt.-Gen. Oleg V. Anisimov, who remained in office until the dissolution of the Soviet Union in late 1991. In 1989 the 67th Independent AEW&C Squadron at Šiauliai, Lithuania, equipped with A-50 *Mainstay-A* aircraft was transformed into a full-size AEW&C regiment with a complement of 20 A-50s; it found a new home at Pechora, Komi Autonomous SSR.

Whereas the 1960s and 1970s had been a busy period for the PVO Aviation's fighter

This MiG-31 seen on final approach sports an unusual yellow code ('81'). The cannon fairing above the starboard main gear unit is clearly visible.

pilots, in the 1980s they did not sit idle either. While heavy aircraft rarely intruded into Soviet airspace after the much-publicised incident with the Korean Air Lines Boeing 707 in Karelia in 1978 (see next chapter), light aircraft became a real nuisance. These were private sports aircraft and light cabin monoplanes (usually from Western Europe) which crossed the border at low altitude, making brief and shallow incursions into Soviet airspace. Occasionally the Soviet PVO succeeded in 'arresting and detaining' such uninvited guests. Thus, in the autumn of 1978 a wayward Chinese light aircraft was intercepted and forced to land at Kirovskiy airport in the Primor'ye Territory. On 30th June 1986 two Iranian light aircraft crossed into Soviet airspace 173 km (107.5 miles) southwest of Baku and were cornered by PVO interceptors on QRA duty and by Border Guards helicopters. One of the intruders was compelled to land at the airport of Kyurdamir (or, in modern Azeri spelling, Kürdamir), a district centre in central Azerbaijan, while the other was brought down near the town of Goradiz (Horadiz) in the Fizuli District. On 25th April 1987 PVO interceptors had to run off another

A MiG-31B at Savasleyka with the IFR probe deployed.

MiG-31B '76 Blue' on short finals to Savasleyka AB; note the deployed periscope in the WSO's cockpit.

Matthias Rust with military and KGB officers beside his Cessna F172P Skyhawk II D-ECJB parked near St. Basil's Cathedral in Red Square.

unbidden guest from Iran near the same spot. (It has to be said that Goradiz frequently became the object of Iranian provocations. One of them, in August 1989, became known as the Goradiz Incident; an Iranian sabotage group trying to escape back across the border on foot was captured by a border patrol, and the Iranians' plan to provoke a border conflict was foiled.)

The 'harassment raids' of light aircraft in the 1980s culminated in the notorious flight of 18-year-old Matthias Rust, a West German national. On 13th May 1987 he departed Uetersen airport near Hamburg in a rented French-built Reims Cessna F172P Skyhawk II registered D-ECJB (c/n F172-02087) which had been modified by replacing the rear seat with long-range tanks. After a two-week trip that took him first to Iceland and then to Norway, on 28th May Rust refuelled at Helsinki-Malmi airport, stating Stockholm as his next destination. Instead, he turned east and headed for Moscow. (Afterwards he claimed that his plan was to land in Moscow with a 'goodwill mission' – to create an 'imaginary bridge' between the East and the West, reducing suspicion and tension between them. However, even western analysts dismiss this story, admitting the flight was a carefully planned and executed provocation staged by the western intelligence agencies.) The Finnish air traffic controllers tried contacting him, as the aircraft was near the busy airway between Helsinki and Moscow, but Rust did not respond, turning off his communications radio. When the Cessna descended to 50 m (164 ft) and disappeared from the ATC radars near Sipoo, Finland, a search and rescue effort was mounted on the assumption that Rust had crashed. The Finnish Border Guard patrol boat involved even found an oil slick near the supposed crash site but the ensuing underwater search turned up no wreckage – because there was none.

The Cessna entered Soviet airspace at 1420 hrs Moscow time over the coast of Estonia near Kohtla-Järve (pronounced '***Kokh**tla-Ya**r**ve*'). At 1429 hrs it was detected by the AD radar in the area, and as the aircraft did not give a positive IFF response it was coded 'hostile'.

Next, however, total confusion set in. Three SAM divisions tracked D-ECJB for a while but were denied permission to fire. A pair of 656th IAP MiG-23MLs launched from Tapa AB east of Tallinn; Lt. (SG) A. Puchnin piloting one of them spotted the target at 1448 hrs, reporting it as a sports aircraft similar to the Yakovlev Yak-12 *Creek*. Yet Rust ignored their signals to follow them, and again the fighter pilots did not receive orders to open fire, losing sight of the low-flying target soon afterwards due to the difference in speed; fairly heavy cloud at 300-600 m (980-1,970 ft) also helped Rust to avoid detection. The reason for this indecision was that after the shootdown of the Korean Air Lines Boeing 747 in 1983, with all the attending bad publicity (see Chapter 5), there was a standing order in the PVO system that forbade fighter pilots and SAM crews to open fire on intruding airliners and sports aircraft in daytime

54th GvIAP MiG-31B '77 Blue' taxying at Savasleyka AB shows the four wing pylons.

MiG-31B '72 Blue' deploys its twin brake parachutes at Savasleyka.

Two Su-27Ps display a mix of differently coloured dielectric parts, with late-style white radomes but early-style green fin caps and other dielectric fairings.

The first photos of the Su-27 to appear in the Soviet press (again, the *Tekhnika i Vo'oruzheniye* magazine). These *Flanker-Bs* belong to a PVO unit.

VMC; no one wanted to accept responsibility for shooting down an unarmed civil aircraft.

As the Cessna flew on in a south-easterly direction, it was mistakenly coded 'friendly' several times. This was the case near Pskov, where the local fighter regiment was conducting flight training, and the rookie pilots forgot to change their IFF codes at 1500 hrs as required; with a dozen 'hostile' aircraft popping up out of nowhere, the local ATC officer manually assigned 'friendly' status to all of them – including D-ECJB. A similar situation occurred near Torzhok (Novgorod Region), where a MiG-25 and a Tu-22M *Backfire* bomber had collided in mid-air and crashed the previous day; the slow propeller-driven aircraft was mistaken for one of the many helicopters involved in the search and rescue effort. Four more fighters took off to intercept – one 790th IAP MiG-25P from Khotilovo AB, two 177th IAP MiG-23Ps from Lodeynoye Pol'e and one 28th GvIAP MiG-23P from Andreapol', but only one of them established contact with the target, and then only briefly. At 1804 hrs the Leningrad PVO Army command post at Taïtsy misidentified the target as a flock of birds. By 1700 hrs the Cessna entered the Moscow PVO District's zone of responsibility. Eventually the aircraft appeared over Moscow's Red Square at around 7 PM; seeing that there were lots of pedestrians in the square making a landing impossible, Rust circled and managed a safe landing on the Bol'shoy Moskvoretskiy Bridge spanning the Moskva River, where – fortuitously for him – the numerous wires normally strung across the bridge had been removed for maintenance that very morning. As Rust parked his aircraft next to St. Basil's Cathedral in Red Square, climbed out and tried to communicate with curious onlookers, enter the law and put the arm on him.

Su-27 '36 Red' flown by Vasiliy Tsymbal during the Orion incident, 941st IAP, Kilp-Yavr AB, September 1987

In September 1987 Rust was brought before trial and found guilty of illegally crossing the Soviet border and breaching aviation law, as well as of gross hooliganism. After serving one year and two months of his four-year sentence he was amnestied as a goodwill gesture, returning to Germany on 3rd August 1988. However, he was not the only casualty. Heads rolled in the Soviet MoD; in particular, the then Minister of Defence Marshal Sergey L. Sokolov and PVO C-in-C Col.-Gen. Aleksandr I. Koldunov were removed from office, as were many of the lower-ranking commanders of the PVO units along the route taken by Rust. The incident was a crippling moral blow to the Soviet military, demonstrating that the nation's air defences were... well, sort of Rusty. Moreover, the Soviet leader Mikhail S. Gorbachov saw this as a pretext to weaken the military lobby opposing him, and virtually all of the nation's top military commanders (including those who had nothing whatever to do with the incident) were removed. This, in fact, was the aim of those who had planned Rust's mission. As for the aircraft, D-ECJB is now on display at the *Deutsches Technikmuseum* in Berlin.

Appetite comes when eating, and the incursions of devil-may-care private flyers continued. On 4th June 1987, just a week after the Rust incident, two light aircraft crossed the Soviet border into Georgia, flying near Tbilisi with impunity. Two more 'mosquito bites' took place on 28th and 29th May 1988; this was a provocation staged to mark the anniversary of Rust's landing. For three days in a row a Norwegian pilot named Andreas Sommers played a game of tag with 941st IAP pilots on his Cessna 152 light aircraft. 'Andryusha Sormovskiy', as he was nicknamed by Soviet pilots, would follow the border for some time, then penetrate 2-3 km (1.25-1.875 miles) into Soviet territory and then beat a hasty retreat, returning into

Armourers push a dolly carrying an R-27ET medium-range AAM (top) and an R-73 short-range AAM into position under the wing of a Su-27P.

Norwegian airspace as soon as a fighter scrambled to intercept. The unit received orders to shoot the intruder down; eventually, however, Sommers obviously decided not to push his luck any further and did not reappear.

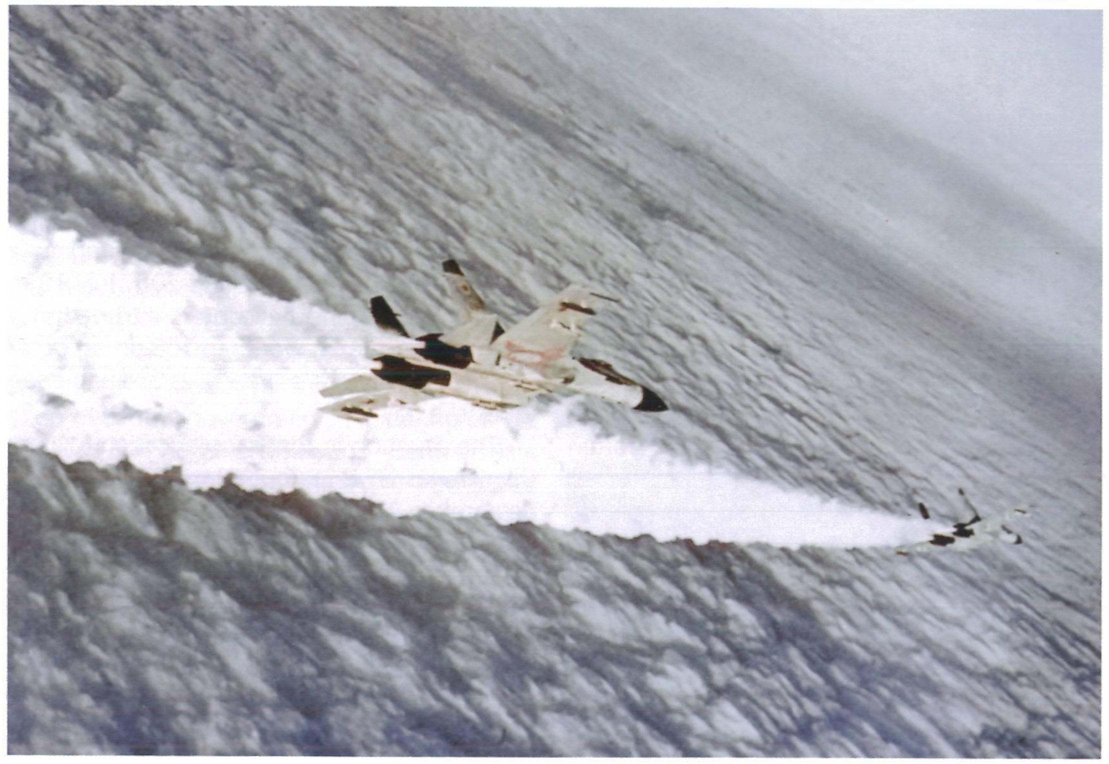
On 22nd April 1989 a private trainer aircraft made a brief incursion into Soviet airspace; just over a month later, on 29th March, an American-registered piston-engined Cessna took off from Alaska, crossing the Soviet border near Ratmanov Island in the Bering Strait. On 9th June 1989 another German – again flying a Cessna 172 – followed in Rust's footsteps. Hans W. Schneider took off from a Turkish airport and landed at Batumi's Chorokh airport in Adjaria, Georgia; leaving a bunch of flowers and a letter on the runway, he took off immediately and returned whence he came. Due to the proximity of the border the PVO fighters did not manage to intercept the Cessna before it left Soviet airspace.

As had been the case in the previous decades, the PVO Aviation and the Air Force worked in close co-operation when it came to dealing with intruders. For example, on 2nd June 1991 it was the Air Force fighters of the Baltic Military District that intercepted a light aircraft intruding from Sweden and compelled it to land at their base. Two weeks later a pair of 6th Independent PVO Army fighters similarly 'busted' a Mooney M20 cabin monoplane belonging to a German national after it had intruded into Soviet airspace from Finland, forcing it to land at Leningrad-Pulkovo airport.

A pair of Su-27Ps in echelon starboard formation.

The red-coded Su-27Ps seen here in the early 1980s are typical early-production examples featuring anti-flutter weights on the fins and green dielectric parts.

An early Su-27P makes a spectacular banked turn at high altitude.



Two Su-27Ps leave contrails as they cruise above an endless sea of overcast.

What colour? This Su-27P sports a red code on the nose and a blue code on the tails, not to mention the differently coloured dielectric parts.

Considering that Air Force and PVO units were now equipped with faster jets (and that means a higher minimum control speed as well!), detecting and intercepting slow-flying targets became a problem. Therefore, unsurprisingly, the PVO took an interest in the Mi-24 *Hind* attack helicopter operated by the Army Aviation; it could prove useful against such targets as light aircraft and balloons (including hot-air filled balloons). Consequently several Mi-24 squadrons were transferred to the PVO Aviation. The 'fighter *Hinds*' saw action against intruders into Soviet airspace, notably in the Kaliningrad PVO District where Mi-24s often had to deal with wayward aircraft – and forced them down at Soviet airfields in several instances.

Despite the Soviet-US rapprochement in the late 1980s, US spyplanes continued probing the Soviet borders with unabated intensity. More than ten incursions were recorded in 1988, and more than 15 the following year. Some 150 reconnaissance missions were flown monthly along the Soviet Union's western borders, and another 70 in the Far East.

When the Soviet Union withdrew from Afghanistan in 1989, ending its ten-year involvement in the Afghan War, hostilities on the other side of the border continued as the local warlords toppled the Kabul government and started fighting for power. Some of the Mujahideen leaders seemed bent on vengeance against the Soviets even after the pullout. Hence provocations on the Afghan border became a common occurrence, sometimes involving Afghan military aircraft operated by one of the warring factions; 47 such incursions took place in the first six months of 1991. On 4th June 1991 an Afghan aircraft even attacked an objective in Tajikistan with bombs, killing four people and wounding a dozen more. Between 1st and 20th July 1991 Afghan aircraft and helicopters intruded into Soviet airspace no fewer than 108 times; occasionally there were as many as six unbidden 'guests' a day!

The situation in the Transcaucasian Military District was anything but relaxed, too. On 2nd September 1990 yet another Iranian aircraft (now operated by the IRIAF – Islamic Republic of Iran Air Force) breached the Soviet border over Azerbaijan. The interceptors scrambling from the nearest base to deal with the intruder quickly hemmed the Iranian in, forcing him to land at Nakhichevan' airport without firing a single shot.

In April 1984 a pair of MiG-25PDSs from Nasosnaya AB near Baku scrambled to intercept a reconnaissance balloon launched from across the border; drifting at 25,000 m (82,020 ft), the balloon was out of reach for any Soviet fighter except the MiG-25. After several abortive attempts one of the pilots succeeded in scoring a direct hit with a missile almost at point-blank range; the missile did not explode but tore a good-sized hole through

several sections of the balloon's envelope (such balloons were made up of multiple sections like an orange for greater survivability). Losing some of its buoyancy, the target descended to 16,000 m (52,490 ft) where MiG-23s summoned for help finished it off with cannon fire.

In the late 1970s/early 1980s Iranian airliners flying one particular weekly service used a route that took them a bit too close to the Soviet border. Hence once a week Soviet interceptor pilots would spend the day sitting in their fighters on QRA duty and waiting for the airliner to appear, ready to 'escort' it and prevent a possible incursion. Finally the Soviet command decided it had had enough and gave orders to deploy two MiG-25PDs to an airbase in Armenia right next to the Iranian border. The pilots chosen for the flight were not given full details of the mission; they were simply ordered to take off and follow the headings they were given, maintaining radio silence all the while. At the last moment one of the pilots smelled a rat, ignored orders and made a U-turn just short of the border. The other pilot, who was not so quick on the uptake, strayed nearly 100 km (62 miles) into Iranian airspace before realising he was on the wrong side of the border and turning back.

On 28th September 1988 a pair of IRIAF helicopters intruded into Soviet airspace. A pair of MiG-23MLDs piloted by Vladmir Astakhov and Boris Gavrilov intercepted them and shot down one helicopter each.

Here it should be noted, however, that in 1990-91 the Soviet Union was already degenerating into a 'Soviet Disunion'; with the relaxation of central government, simmering ethnic tensions in Transcaucasia and Central Asia erupted into civil wars which the authorities could not suppress. The belligerents would try – often successfully – to obtain weapons by overrunning nearby Soviet military bases, some of which were plundered. Also, as the Soviet republics declared sovereignty they laid claim to whatever Soviet military assets were on their territory.

The airmen of the units stationed in the High North had a busy time, too. For example, the 72nd GvIAP at Amderma converted to the MiG-31 in December 1986 and one of its squadrons assumed active duty on 27th May 1987. That very day a MiG-31 crew comprising pilot Guards Capt. Yuriy N. Moiseyev and Guards Capt. Oleg A. Krasnov had to demonstrate their command of the new mount, warding off an SR-71 and forcing it to withdraw to international waters.

An interesting aspect of two red-coded Su-27Ps. Note the variations in camouflage colours (the lead aircraft appears to have weathered paintwork).

The same pair contrailing across a vast expanse of woodland.

Blue-coded Su-27P interceptors operated by the 54th GvIAP stand on ready alert at Savasleyka AB.

Opposite, top: Su-27P '01 Red' armed with R-27T and R-27ER AAMs deploys its airbrake fully to keep formation with the slow camera ship.

Lt. (SG) Vasiliy Tsymbal in the cockpit of 941st IAP Su-27 '36 Red' during the famous incident with the Norwegian P-3B '602'.

Another picture of Tsymbal's Su-27 taken from the Orion. This photo was taken minutes before the collision.

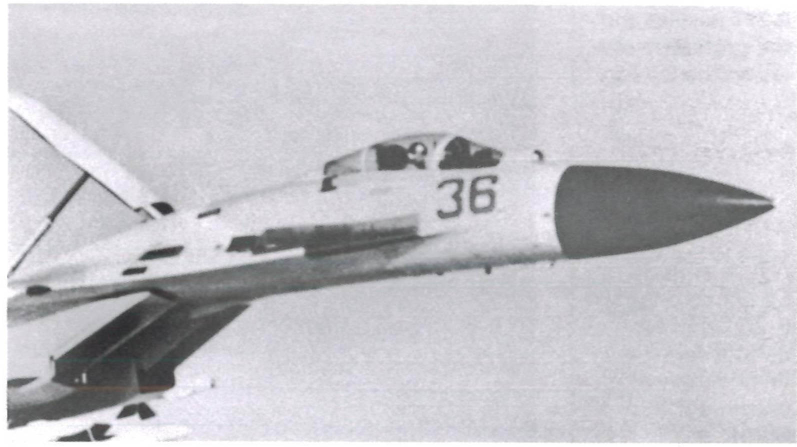
As noted earlier, in the 1980s the PVO Aviation began a massive re-equipment effort that gave it a major capability boost, converting to the MiG-31 and the Su-27P. (The Air Defence Force's missile units were not left out either: the new S-300 SAM system and new ECM systems were fielded.) In so doing the High North and the Far East enjoyed priority – especially the Far East because the Kurile Islands, Sakhalin Island and the Kamchatka Peninsula received the attention of not only spyplanes operating from Alaska and Japan but also US Pacific Fleet carrier-based aircraft. The situation became really hectic during the annual US/South Korean exercise *Team Spirit*; fighter pilots from the PVO units based on Sakhalin and the South Kuriles would jokingly refer to this exercise as 'trilateral' – that is, US/South Korean/Soviet, because they had to keep the Americans and Koreans at bay.

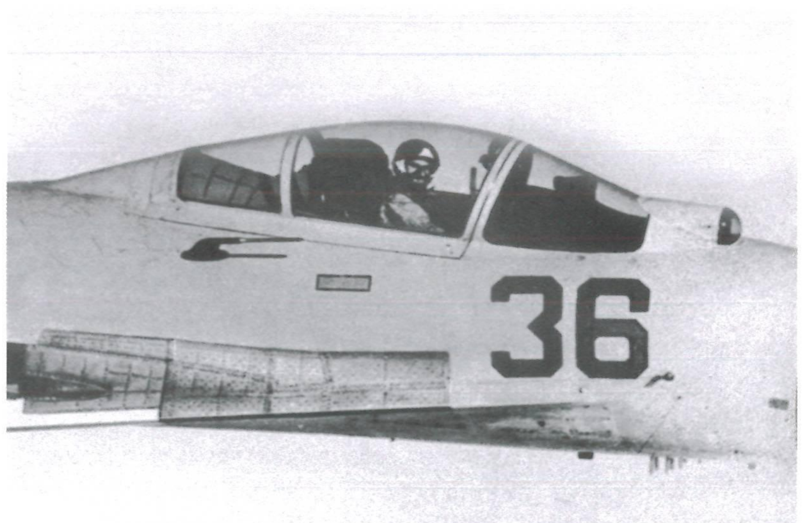
Until the introduction of the *Flanker* and *Foxhound*, the US Navy Grumman F-14 Tomcats and McDonnell Douglas F/A-18 Hornets and USAF McDonnell Douglas F-15 Eagles were up against the MiG-23P, MiG-23MLD, Su-15TM and MiG-25PD/MiG-25PDS, which were usually no match for the Americans. Occasionally the MiG-23 came out victorious from a mock dogfight with the Tomcat, but only thanks to the MiG driver's skill, not technical ascendancy. The less manoeuvrable Su-15 fared even worse when it came to close encounters with US fighters. *Flagon* pilot Maj. Aleksey Deyev had an embarrassing incident when five Hornets 'boxed him in' and he barely managed to shake them off his tail.

The agile Su-27P changed the situation completely. When Exercise *Team Spirit '89* began, the *Flankers* showed some particularly impudent Americans the old what-for. The same Maj. Aleksey Deyev, now flying a Su-27P, once latched onto a pesky Lockheed P-3 Orion anti-submarine warfare aircraft that was getting too close to Soviet shores, and was so determined to drive it off that at length the exasperated P-3 pilot yelled in Russian (!) on the radio, demanding to be left alone and displaying a perfect command of Russian bad language! Small wonder that some of the regiment's pilots, including Deyev, received government awards after the exercise.

The intensity of the interceptors' operations in the Far East is vividly illustrated by the statistics of just one PVO regiment – the 865th IAP based on Kamchatka, which converted to the MiG-31 early in the second half of the 1980s. In 1987 the regiment's pilots flew 214 missions to ward off reconnaissance aircraft, and in 1988 there were 825 such missions. Much nuisance was caused by SR-71s, P-3s and RC-135s.

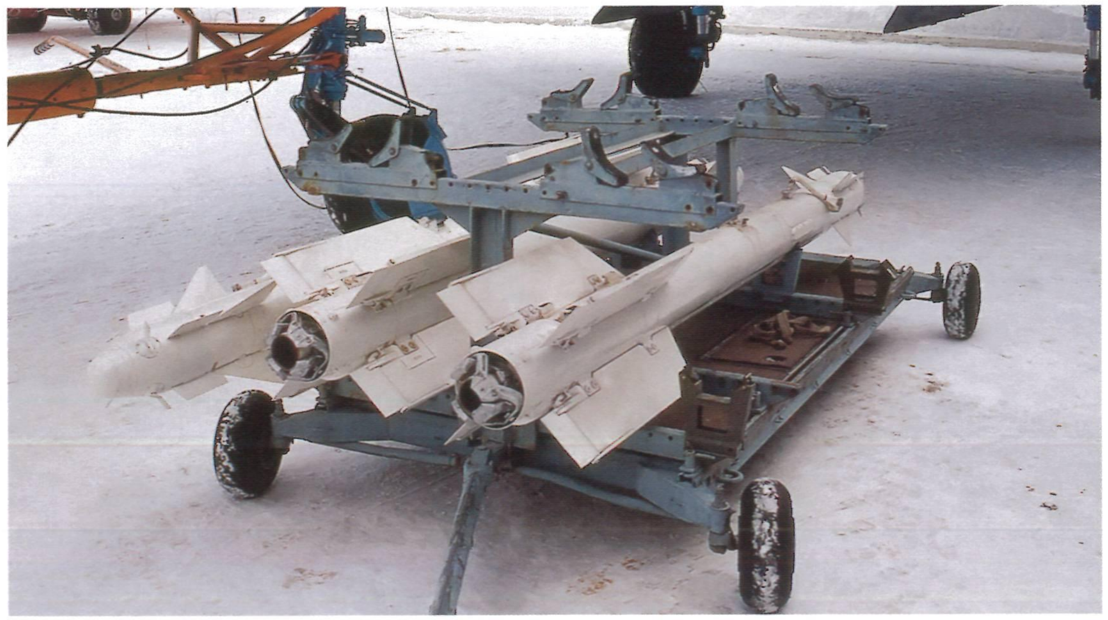
The Kola Peninsula also constantly received the attention of the NATO's intelligence serv-





ices. In 1987 the pilots of the 174th GvIAP based at Monchegorsk carried out 203 missions to escort foreign aircraft away from the Soviet border; this figure included 69 missions against SR-71s operating out of RAF Mildenhall. In 1988 the intensity of the combat work escalated further, with 436 missions (the Blackbird was the target in 86 cases); in 1989 the number of intercept missions fell to 270. Apart from intercepting real-life targets, the pilots of the regiment took part in various exercises – ***Sev****er-87* (North-87), *Otra**zhe**niye-88* (Rebuff-88) and others, where they fired at target drones. In the course of these exercises the possibility of stationing operational MiG-31s at an ice airstrip on the Zemlya Frantsa Iosifa (Franz Josef Land) archipelago was tested. Working alongside the aircrews of the 174th GvIAP were the MiG-31s the 365th IAP from Kem' and the 72nd GvIAP from Amderma.

The MiG-31's first mission was to counteract the reconnaissance flights of the SR-71s. The Blackbirds used a harassment tactic, intruding into Soviet airspace to a depth of several dozen kilometres and challenging the PVO system to undertake actions in response. The very short time spent by these aircraft over Soviet territory made it all but impossible to shoot them down with a surface-to-air missile; yet, the radar systems of the PVO were switched to combat alert mode, and the operational



Three R-73 AAMs on a ground handling dolly built for six such missiles. Note the missile's reaction control vanes augmenting the forward-mounted rudders.

'03 Blue', a 9th GvIAP Su-27P wearing wolf artwork, sits in a revetment at Kilp-Yavr AB, with a missile dolly loaded with two R-27Ts and two R-73s in the foreground. The difference in the missiles' size is striking. Note the differently coloured IR seeker heads on the R-27T missiles and the protective covers on the R-73s.

A fully armed Su-27P carrying six R-27s and four R-73s is seen immediately after becoming airborne.

parameters of the systems were comfortably recorded by a USAF ELINT aircraft flying over international waters.

While the introduction of the MiG-31 did not cause the NATO to curtail its flights along Soviet borders, the cases of reconnaissance aircraft coming too close became less frequent. For example, until 1984 the 365th IAP equipped with Su-15TMs had proved impotent against the SR-71; with the advent of the MiG-31 the Blackbird crews quickly realised it was best to stay away from the Soviet border. As an example one can cite an intercept which took place on 8th March 1984: a pair of MiG-31s blocked an SR-71 so effectively over international waters that it had to return to base without fulfilling its mission.

While we are on the subject it is worth quoting the recollections of Oleg P. Vydrenok, a former Tu-128 pilot and subsequently a MiG-31 pilot with the 518th IAP at Arkhangel'sk-Talagi and in the Far East:

'For the PVO pilots pulling combat duty in the North and the Far East in those long-gone days, scrambles from QRA duty to intercept foreign aircraft were commonplace. NATO ASW aircraft were constantly prowling around the Kola Peninsula, waiting for our submarines to put to sea. RC-135 ELINT aircraft put in an appearance whenever a major event was brewing in the area, be it any Navy or Air Force exercise, live weapons training with missiles at target ranges, cruise missile tests or practice/test launches of sea-launched ballistic missiles against the Kura target range on the Kamchatka Peninsula. They also appeared if the command posts' or GCI stations' radio frequencies were changed, new AD radars or radio relay stations were commissioned etc.

The SR-71s were also frequent visitors, almost operating a scheduled service. The Blackbirds followed two routes known as the "right loop" and the "left loop"; the reason for this is not entirely clear. They would take off from a base in England (RAF Mildenhall – Auth.)*, refuel over the Norwegian Sea and start an accelerating climb. They would enter their flight pattern at 20,000-24,000 m [65,620-78,740 ft], travelling at 3,000-3,300 km/h [1,863-2,050 mph]. In the case of the "left loop" the SR-71 followed the coast of the Kola Peninsula, the Kanin Peninsula, Kolguyev Island and then initiated a left turn near Novaya Zemlya towards Norway, whereupon it descended, refuelled again and landed in England again. In the case of the "right loop" the SR-71 flew eastward to Novaya Zemlya, then began a right turn to pass Kolguyev Island, the Kanin Peninsula, the Kola Peninsula, then proceeded towards Norway, refuelling and landing in England. All the while our entire air defence assets in the area – SAM sites, radar sites and aviation – were placed on maximum alert; the interceptors took off from their bases and proceeded to their respective designated intercept points from where they could launch an attack at a moment's notice, should the SR-71 enter Soviet airspace, so that the wreckage would fall in Soviet territorial waters. Yet the SR-71s took care not to breach the border (or "cross the ribbon", to use a slang expression); all the while it recorded all the PVO assets tracking it, being chock full of reconnaissance equipment.*

On one occasion an SR-71 following the "right loop" had a mishap – probably an engine failure; aborting the mission, the aircraft started descending rapidly from its service ceiling to a flight level that presumably allowed it to fly stably on one engine. Our listening posts recorded intensive radio communications between the SR-71's crew and the command post in Norway (the SR-71 made a safe landing at a Norwegian base).

I flew some five intercept missions against the SR-71 from Talagi. Later I was transferred to a unit based at [Petropavlovsk-Kamchatskiy/] Yelizovo on Kamchatka which was transitioning to the MiG-31 and required instructor pilots, pilots to pull QRA duty, ferry pilots to deliver the aircraft from the factory etc.

On Kamchatka, too, I had to fly QRA missions a good deal against the P-3C Orion, the RC-135 and the SR-71. Let me tell you about one of these sorties.

Having browsed through my pilot's log, I found the sortie in question. It was 12th February 1988, and the target was an SR-71. Again, the Blackbird flew "scheduled services" to Kamchatka, so the intercept was fairly routine, the sortie being timed down to the second. At a prearranged time I climbed into the cockpit, took off as ordered and then ignited the afterburners at a predetermined point, climbed and proceeded to the loiter area, waiting to see if the SR-71 would intrude into our airspace. Yet, they must have had good [navigation] computers because they never did intrude.

It was all cut and dried, and the "adversaries" were used to it. However, all of a sudden someone in the top echelons decided to check the "adversary's" vigilance and a new intercept route was devised. Normally a single MiG-31 would greet the SR-71 in head-on mode over Kamchatka; this time, however,

The Guards badge worn on the parade dress of Guards units' personnel.

A red-coded Su-27P uses both its airbrake and the twin cruciform brake parachutes to kill its speed after landing.

there were two MiG-31s – the other aircraft headed far out into the Pacific. The reason was that the SR-71 invariably approached the coast of Kamchatka at right angles, travelling at 22,000-24,000 m [72,180-78,740 ft], then turned left and proceeded towards Okinawa, all but brushing the "ribbon". Our navigators plotted the course of action down to the second – what we would do to make sure that, when the SR-71 (flying higher and faster on the same track) would arrive at the turning point, the [second] MiG-31 would be at optimum range for a missile attack in pursuit mode, should the Blackbird cross the border. Then we would nail it from both ends!

Well, the pair took off, and one aircraft proceeded into the interior of Kamchatka as per usual while I followed the new route towards the SR-71's anticipated turning point over the Pacific. We did everything right: I accelerated to Mach 2.83 and climbed to 20,000 m, awaiting orders from the command post. Soon I was told that the SR-71 was gaining on me. When the controller told me, "Target straight overhead, 2,000 m [6,560 ft] above you", I banked the aircraft because the canopy frame and the "pot" on my head (the GSh-6A pressure helmet) were impairing my ability to look up. I did not spot it at first because I was looking in the wrong direction. Then, first I glimpsed a glint of sun and a very brief contrail, and presently I saw the aircraft itself. It was not very clearly visible, just a black silhouette against a dark blue sky, and it was overtaking me quite rapidly – on such missions they were doing about 3,300 km/h. When the command post told me the target range was about 10 km [6.2 miles] I told my WSO, "Radar on". Two or three seconds later, while still a few kilometres short of its usual waypoint, the Blackbird made an abrupt turn to the left and hightailed it to the Pacific instead of taking the customary route to Okinawa. Apparently its radar homing and warning system was working OK, alerting the crew that we had detection and lock-on. Moreover, at this short range our powerful radar must have given its highly sensitive SIGINT equipment such a "whack" that the Americans did not feel inclined to play cat and mouse with us. The situation was clearly not developing according to the scenario they had expected.

The showdown lasted only a few seconds, but that was all we needed. The SR-71 was over international waters and we could not do anything to it (much less attack it). After all, the American had not done anything untoward, he had not violated the border – he had merely appeared over this part of the sea out of curiosity. Well, neither had I done anything untoward – I had merely turned on my radar to see where he was and what he was doing. As for the "Attack" message on my head-up display, it's not my fault – that's the way the MiG-31's radar works, having detected a target, it locks on and shows a "ready to attack" message. As for the American changing his course so abruptly – it's up to him; perhaps he had decided to take a short cut to his base in Japan.

I don't know what the SR-71 did next. I had to head back to base because I was getting short on fuel. This is how I ran off the highly-touted Blackbird once. Looking back on it now, I recall that the SR-71s stopped appearing over Kamchatka for a suspiciously long time; later, however, everything returned to normal and they resumed their flights, testing the vigilance of our QRA forces.

You'd like to know if I would have shot the Blackbird down if ordered to? Well, that's a good question. Political tensions were running high, and you can guess how the outside world viewed the Soviet people (especially Soviet pilots) after the [South Korean] Boeing had been downed by a Su-15 over Moneron Island near Sakhalin. But I was a military pilot, an Air Defence Force pilot, and I had been trained for many years to do what it takes to stop some hotheads from turning our peaceful skies into wartime skies. Therefore I would not hesitate – orders must be carried out by whatever means possible.

In the case of the SR-71, when I was intercepting it in head-on mode the closing rate was such that I had no time to reflect. Add up 3,000 km/h and 3,300 km/h and try to figure out how many kilometres per second that is (1.75 km/sec or 1.08 miles/sec – *Auth.*). *There would be only a few seconds between lock-on and the point when the target was too close for attack; given an incursion, I know my finger would have pushed the launch button automatically – I would not have sat awaiting orders. It's better to be disciplined afterwards for shooting down an intruder without orders than to be disciplined for doing nothing because I was waiting for orders from the command post or some big shot from Moscow. Remember the Rust case – the whole "corrida" had lasted several hours, while here I would have had seconds at my disposal. Also, you know the saying: success is never blamed!"*

A 941st IAP Su-27P coded '36 Red' gained notoriety after widely publicised incident on 13th September 1987 involving a Royal Norwegian Air Force (333 Sqn) Lockheed P-3B serialled 602 (c/n 185-5304). The Orion had launched from Andøya AB to shadow a group of Soviet Navy/North Fleet ships in the Barents Sea. When the P-3 started dropping sonobuoys in order to track a Soviet submarine, Lt. (SG) Vasiliy Tsymbal flying Su-27P '36 Red' was ordered to prevent it. Trying to 'squeeze' the Orion out, the fighter came up on the port flank, then positioned itself ahead of the P-3 so as to shake it with wake turbulence. Still, the Orion's crew doggedly kept doing their job. The Norwegian aircraft's captain 1st Lt. Jan Salvesen reduced speed, hoping that the Su-27 would overshoot. However, he was unaware of the *Flanker's* low-speed handling capabilities, and as the Su-27 slowed down to keep formation the Norwegian crew briefly lost sight of it.

Possibly trying to get a real close look at the Orion, Tsymbal manoeuvred the fighter dan-

An enamel badge marking the 40th anniversary of the PVO's Daugavpils Military Air Engineering College (DVVAIU).

A fine perspective of a PVO Su-27UB coded '44 Blue', with obvious signs of having worn a different code previously.

54th GvIAP MiG-31B '51 Blue' formates with an IL-78 tanker. Note the extended periscope and IFR probe.

gerously close to it and the port fin made contact with the Orion's No.4 propeller. The dielectric fin cap enclosing an antenna shattered immediately, but so did the propeller and fragments of it punctured the fuselage skin, causing decompression. The damaged propeller caused violent vibration, forcing the crew to shut down the engine and make for home. The Su-27, too, landed safely at Kilp-Yavr.

A huge investigation was mounted, and reprisal was swift. Three days after the incident Tsymbal was expelled from the Communist Party – a very severe punishment by Soviet standards. One day later, however, he was reinstated. Shortly afterwards he was awarded the Order of the Red Star and transferred to a unit based in Rostov-on-Don – in a nutshell, kicked upstairs. The Soviet Union officially apologised for the incident; however, the report of the Soviet accident investigation board stated unambiguously that both pilots were to blame – a point debated by the Norwegian MoD. Anyway, Jan Salvesen emerged from the incident with an unblemished service record.

After this incident the fighter involved in the collision was recoded '38 Red' – possibly to avoid unwanted interest in this aircraft. Thus, should any party make claims, stating the aircraft's tactical code as '36 Red', the Soviet authorities would reply that no such aircraft was operated by the Soviet Air Force units stationed in the north – which would be perfectly true. Eventually, however, no one stated any political claims. The reader may be interested to know that the famous Su-27 did gain special markings – a triangular flash in Russian flag colours. Additionally, one of the five 'kill' stars painted on the port side of the nose was superimposed on the silhouette of a P-3!

In 1988 the 941st IAP lost one of its single-seat Su-27s. Piloted by Capt. Mikhail Shvetsov, the fighter had scrambled from Kilp-Yavr AB to ward off an unidentified aircraft lurking near the Soviet border. In the course of the mission the aircraft was vectored towards a second target and then towards a third one, despite the fact that it was running low on fuel. Realising that the Su-27 would not make it back to base, the ATC officer at Kilp-Yavr directed the fighter towards an alternate airfield, the Navy's Severomorsk-3 AB. Coming in to land with 'bingo fuel', the tired pilot misjudged his landing approach and touched down at an angle to the runway centreline. As a result, the fighter veered off the runway, suffering irreparable damage; thankfully the pilot walked away.

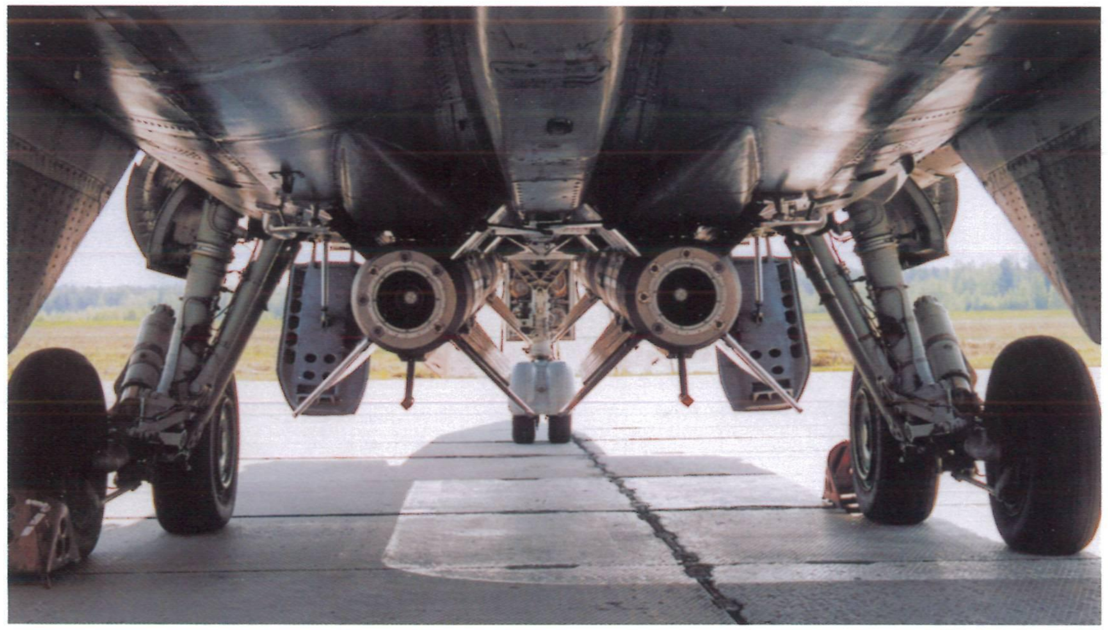
As of 1988 the Soviet Air Defence Force included a total of 86 air regiments. At the moment of the Soviet Union's demise in late 1991 the Air Defence Force comprised the Moscow PVO District and nine independent PVO armies, which encompassed 18 air corps, including two independent corps, and 16 air divisions. The Moscow PVO District was the last of the kind (the other PVO Districts established back in the 1950s had been reorganised by then). Throughout its history dating back to August 1954 it had been commanded mostly by airmen – Air Marshal Anatoliy U. Konstantinov (1980-87), Col.-Gen. Aleksandr I. Koldunov (1970-75), Col.-Gen. Boris V. Bochkov (1975-80), Col.-Gen. Vladimir G. Tsar'kov (1987-89), Col.-Gen. Viktor A. Proodnikov (1989-September 1991). This is despite the fact that most of the units in the Moscow PVO District were SAM units, not air regiments. The only non-airmen who commanded the district were Army General Pavel F. Batitskiy (1954-65) and Col.-Gen. Vasiliy V. Okunev (1966-70).

An enamel badge marking the 50th anniversary of the 777th IAP in 1992, showing a stylised fighter over Sakhalin where the unit was based.

Head-on view of MiG-31B '77 Blue' at Savasleyka with four R-33s and four R-60Ms attached.

At the time of the Soviet Union's demise the PVO Aviation fleet comprised about 2,220 assorted fighters and interceptors. As the former Soviet republics became sovereign states, many PVO Aviation units with their personnel and materiel were left outside Russia. While a large proportion of the PVO's assets was appropriated by the newly-independent Armenia, Azerbaijan, Belorussia, Georgia and the Ukraine, some units did redeploy to Russia, thereby reducing the impact. At the end of the day the Russian Federation was left with approximately 65% of the former Soviet Air Defence Force's assets at the moment of dissolution.

Nearly all European PVO Aviation fighter regiments took live weapons training at the 18th TsBP each summer. Also, Krasnovodsk hosted a training centre where Algerian, Iraqi and Libyan MiG-25PD pilots took their training.



This view shows the nozzles of the rear pair of R-33 missiles, details of the MiG-31's main gear units and the inside of the forward pair of main gear doors which double as air-brakes.

PVO Aviation order of battle in 1987-1991 [1]

Unit	Base	Aircraft (types/quantity, where known)
Direct reporting units		
Aircraft storage depot	Rzhev, Kalinin Region [2]	Tu-128M
2179th BRS	Bobrovka AB, Kuibyshev Region [3]	109 Su-15s, 26 MiG-23s
144th OAP DRLO	Pechora, Komi ASSR	A-50
...th OIAP	Privolzhskiy AB, Astrakhan' Region	MiG-29
235th OSAE	Kapustin Yar, Astrakhan' Region	Mi-8
148th TsBP i PLS	Savasleyka AB	16 Su-27Ps/Su-27UBs 12 MiG-31s, 4 MiG-25PUs 16 MiG-23MLDs
18th TsBP	Krasnovodsk, Turkmenia	MiG-25PDS/MiG-25PU MiG-23M/MiG-23UB MiG-29 *Fulcrum-A* (one squadron each)
116th TsBP	Astrakhan'	14 MiG-21s 14 MiG-23s
Armavir Red Banner VVAUL		
627th *Ternopol'skiy* GvUAP	Sal'yany AB	84 Aero L-39Cs
709th UAP	Maikop, Stavropol' Territory	107 MiG-21s
713th UAP	Armavir, Krasnodar Territory	80 MiG-23s
761st *Polotskiy* UAP	Adjikabul', nr Baku, Azerbaijan	84 Aero L-39Cs 109 Aero L-29s
Stavropol' VVAULSh		
218th UAP	Sal'sk, Rostov Region	76 MiG-23s
382nd UAP	Khankala AB, Groznyy, Chechen-Ingush ASSR	89 Aero L-39Cs 79 Aero L-29s
700th UAP	Tikhoretsk, Krasnodar Territory	81 Su-15s
762nd UAP	Kholodnogorsk, Stavropol' Territory	100 Aero L-39Cs
Moscow PVO District (HQ Moscow)		
28th *Leningradskiy* GvIAP	Andreapol', Kalinin Region	38 MiG-23P/MiG-23UBs
153rd IAP	Morshansk, Tambov Region	18 MiG-31s 4 MiG-25PUs
191st IAP	Yefremov, Tula Region	38 MiG-23P/MiG-23UBs
415th IAP	Yaroslavl'-Toonoshna AP	38 MiG-23P/MiG-23UBs
472nd IAP	Kursk-Khalino AP	38 MiG-23P/MiG-23UBs
611th IAP	Dorokhovo AB, Bezhetsk, Kalinin Region	39 Su-15TM/Su-15UMs, later Su-27P/Su-27UBs
786th IAP	Pravdinsk, Gor'kiy Region	31 MiG-31s 5 MiG-25PUs
790th IAP	Khotilovo AB, Bologoye, Kalinin Region	38 MiG-25PD/MiG-25PUs, later MiG-31s
436th OTAP	Stoopino-6 AB, Moscow Region	7 Mi-8Ts
45th IAP	Vyaz'ma, Smolensk Region	MiG-23P/MiG-23UB
401st IAP	Smolensk	MiG-23M/ MiG-23P/MiG-23UB
404th IAP	Orlovka (Vernoye) AB	MiG-23P/MiG-23UB, later Su-27P/Su-27UB
28th IAP	Krichev, Mogilyov Region, Belorussia	38 MiG-25PD/MiG-25PUs
2nd Independent PVO Army (HQ Minsk, Belorussia)		
61st IAP	Baranovichi, Belorussia	3 MiG-25PDSs 25 MiG-23MLD/MiG-23UBs, later 23 Su-27Ps/a few Su-27UBs
201st IAP	Machoolishchi AB, Minsk	38 MiG-23MLD/MiG-23UBs

4th Independent PVO Army (HQ Sverdlovsk)		
681st IAP	Danilovo AB, Kuibyshev Region	38 MiG-23MLD/MiG-23UBs
683rd IAP	Bobrovka AB, Kuibyshev Region	38 MiG-23P/MiG-23UBs
763rd (or 412th?) IAP	Dombarovskiy, Orenburg Region	MiG-23P/MiG-23UB
764th IAP	Perm'-Bol'shoye Savino AP	38 MiG-25PD (PDS?)/MiG-25PUs, later MiG-31s
765th IAP	Salka, nr Nizhniy Tagil, Sverdlovsk Region	MiG-23P/MiG-23UB
6th Independent PVO Army (HQ Leningrad)		
54th *Kerchenskiy* GvIAP	Vaïnode, Latvia	38 Su-27P/Su-27UBs
177th IAP	Lodeynoye Pol'e, Leningrad Region	38 MiG-23P/MiG-23UBs, later Su-27P/Su-27UBs
180th *Volgogradskiy* GvIAP	Gromovo AB, Leningrad Region	31 MiG-31s, later MiG-31BSs
366th IAP	Pärnu, Estonia	MiG-23
384th IAP	Tallinn, Estonia	MiG-23
425th IAP	Haapsalu AB, Estonia	38 MiG-23s
655th IAP	Pärnu, Estonia	42 MiG-23ML/MiG-23UBs
656th IAP	Tapa AB, Estonia	38 MiG-23ML/MiG-23UBs
...th OVE [4]	Tapa AB, Estonia	10 Mi-24s
689th *Sandomirskiy* GvIAP	Neevenskoye AB, Kaliningrad Region	36 Su-27P/Su-27UBs
8th Independent PVO Army (HQ Kiev, the Ukraine)		
62nd IAP	Bel'bek AB, Sevatopol', Crimea Region	39 Su-15TM/Su-15UMs, later Su-27P/Su-27UBs (14 delivered, Su-15 operations continued)
136th GvIAP	Kirovskoye AB, Crimea Region	Su-27P/Su-27UB
146th GvIAP	Vasil'kov, Kiev Region	41 MiG-25PD/MiG-25PUs
636th IAP	Kramatorsk, Donetsk Region	39 Su-15TM/Su-15UMs, MiG-23P/MiG-23UB
737th IAP	Chervonoglinskaya AB, Artsiz, Odessa Region	36 MiG-23ML/MiG-23UBs
738th IAP	Mokraya AB, Zaporozhye	MiG-25PD/MiG-25PUs; disbanded 1990, aircraft transferred to 152nd IAP, Ak-Tepe
933rd IAP	Kaïdaki AB, Dnepropetrovsk	40 MiG-25PD/MiG-25PUs
831st IAP	Mirgorod, Poltava Region	Su-15
223rd OSAP	Kiev-Zhulyany AP	An-24B, An-26, Mi-8PS
179th *Yaroslavskiy* IAP	Stryy, L'vov Region	43 MiG-23MLD/MiG-23UBs
894th IAP	Ozyornoye AB, Zhitomir, Zhitomir Region	38 MiG-23s
10th Independent PVO Army (HQ Arkhangel'sk)		
359th OTAP	Arkhangel'sk-Vas'kovo AP	Transport aircraft 10 Mi-8s, 3 Mi-26s
387th OVE	Kilp-Yavr AB, Murmansk Region	10 Mi-24s
57th GvIAP	Noril'sk, Krasnoyarsk Territory	Su-15
72nd *Polotskiy* GvIAP	Amderma, Nenets Autonomous District	31 MiG-31s
174th *Pechengskiy* IAP	Monchegorsk, Murmansk Region	29 MiG-31s, 6 MiG-25PUs
265th IAP	Poduzhem'ye, nr Kem', Karelia	39 Su-15TM/Su-15UMs, later Su-27P/Su-27UBs
431st IAP	Afrikanda, Murmansk Region	39 Su-15TM/Su-15UMs, later Su-27P/Su-27UBs
470th IAP	Afrikanda, Murmansk Region	Su-27P/Su-27UBs
445th IAP	Kotlas, Arkhangel'sk Region	41 MiG-25PDS/MiG-25PUs
518th *Berlinskiy* IAP	Arkhangel'sk-Talagi AP	31 MiG-31s
524th IAP	Letneozyorsk AB, Arkhangel'sk Region	39 MiG-25PD/MiG-25PUs
641st *Vilenskiy* GvIAP	Rogachovo AB, Novaya Zemlya	32 Su-27P/Su-27UBs, 2 Mi-8s
941st IAP	Kilp-Yavr AB, Murmansk Region	38 Su-27P/Su-27UBs
991st IAP	Petrozavodsk-Besovets AP, Republic of Karelia, Russia	MiG-25PD/MiG-25PU

11th Independent PVO Army (HQ Khabarovsk)		
22nd GvIAP	Tsentral'naya-Ooglovaya AB, Artyom, nr Vladivostok, Primor'ye Territory	MiG-23MLD/MiG-23UB
41st IAP	Postovaya AB (Orlovka), nr Sovetskaya Gavan', Khabarovsk Territory	40 MiG-23MLD/MiG-23UBs
47th IAP	Zolotaya Dolina AB (Unashi), nr Nakhodka, Primor'ye Territory	Su-27P/Su-27UB
60th IAP	Komsomol'sk-on-Amur/Dzyomgi, Khabarovsk Territory	Su-27P/Su-27UB
171st IAP	Oogol'nyye Kopi (Anadyr'-Oogol'nyy AP)	Su-15TM/Su-15UM
301st GvIAP	Kalinka (Desyatyy Oochastok) AB, Khabarovsk Territory	MiG-23MLD/MiG-23UB
308th IAP	Sovetskaya Gavan', Khabarovsk Territory	36 MiG-23MLD/MiG-23UBs
777th IAP	Sokol AB (Dolinsk), Sakhalin	32 MiG-31s
387th IAP	Boorevesnik AB, Iturup Island, the Kuriles	40 MiG-23MLD/MiG-23UBs
865th GvIAP	Petropavlovsk-Kamchatskiy/Yelizovo AP	MiG-31
530th IAP	Chugooyevka AB, Primor'ye Territory	MiG-25PD/MiG-25PUs, later 36 MiG-31s
528th IAP	Smirnykh AB, Sakhalin	MiG-23ML
12th Independent PVO Army (HQ Tashkent, Uzbekistan)		
9th *Odesskiy* GvIAP	Chirchik & Andizhan, Uzbekistan	Su-15/Su-15TM, later 32 Su-27P/Su-27UBs
179th *Transil'vanskiy* GvIAP	Nebit-Dag, Turkmenia	MiG-23M
152nd GvIAP	Ak-Tepe AB, nr Ashkhabad, Turkmenia	MiG-23M, MiG-25PD
14th Independent PVO Army (HQ Novosibirsk)		
64th IAP	Omsk-Severnyy AP, Omsk Region, Russia	32 MiG-31s
350th IAP	Belaya AB, Irkutsk Region	24 MiG-31s
356th IAP	Zhana-Semey AB, Semipalatinsk	32 MiG-31s, 3 MiG-25PUs
812th IAP	Aleysk, Altai Territory	MiG-23
813th IAP	Novosibirsk	Su-15TM/Su-15UM
849th IAP	Koopino AB, Novosibirsk Region	MiG-23ML/MiG-23UB, aircraft later transferred to Ucharal, Kazakhstan
712th *Chernovitskiy* IAP	Kansk, Krasnoyarsk Territory	Su-15TM/Su-15UM, later conversion to MiG-31
22nd *Khalkhingol'skiy* IAP	Bezrechnaya AB, Chita Region	40 Su-15TM/Su-15UMs (or MiG-23ML/MiG-23UBs)
19th Independent PVO Army (HQ Tbilisi, Georgia)		
359th OTAE	Sandar AB, Marneuli nr Tbilisi	Transport aircraft 5 Mi-8s, 3 Mi-26s
386th OVE	Sangachaly AB, nr Baku, Azerbaijan	10 Mi-24s
50th IAP	Nasosnaya AB, nr Baku	MiG-25PDS/MiG-25PU
82nd IAP	Nasosnaya AB, nr Baku	38 MiG-25PDS/MiG-25PUs
83rd GvIAP	Rostov-on-Don, Russia	40 MiG-25PDS/MiG-25PUs, later MiG-31s
171st *Tool'skiy* GvIAP	Bombora AB, nr Gudauta, Georgia	Su-27P/Su-27UB
529th GvIAP	Bombora AB, nr Gudauta, Georgia	34 Su-27P/Su-27UBs
166th GvIAP	Marneuli AB, nr Sandar	40 Su-15TM/Su-15UMs
393rd *Baranovichskiy* GvIAP (later 209th IAP)	Privolzhskiy AB, Astrakhan' Region, Russia	38 MiG-23MLA/MiG-23UBs
562nd IAP	Krymsk, Krasnodar Territory	35 Su-27P/Su-27UBs

1. The SAM, radar and auxiliary units that were part of the direct reporting units, the Moscow PVO District and the independent PVO armies. Also, the constituent corps and divisions within each independent PVO army are not listed for the sake of simplicity.
2. now Tver' Region
3. now Samara Region
4. OVE = ot***del'****naya verto***lyot***naya eskad***ril'***ya* – independent helicopter squadron

5 The Korean Airliner Incidents

As a matter of fact, proper spyplanes (PHOTINT/ELINT aircraft) and light aircraft flown by 'aerial hooligans' were not the only ones to enter Soviet airspace illegally and be fired upon. Civil airliners occasionally strayed into Soviet airspace when they were not supposed to. While these incursions were invariably described as the result of navigation errors, this was not always the case.

On two occasions the incursions resulted in the airliner being shot down. By curious coincidence, both aircraft were Boeings, both were operated by the South Korean flag carrier Korean Air Lines (KAL) – and both were downed by a Su-15TM.

The first shootdown occurred on 20th April 1978. That day a Korean Air Lines Boeing 707-321BA-H registered HL7429 (c/n 19363, fuselage number 623) and captained by Kim Chang Kyu departed Paris-Charles de Gaulle at 1440 hrs UTC, bound for Seoul via Anchorage, Alaska, on flight KE902 with 97 passengers (including five children) and 12 crew. Everything was normal until the aircraft had passed over Greenland and reached Cape Columbia, the northern extremity of Ellesmere Island, Canada. In his book *Flights of Terror – Aerial Hijack and Sabotage since 1930*, David Gero wrote: *'Built more than a decade earlier, the aircraft lacked a modern inertial navigation system, and as a magnetic compass is useless in this part of the world* (it gives false readings due to the proximity of the North Pole – *Auth.*), *and with a scarcity in ground aids, the crew would have to rely upon the older but well-proven method of celestial navigation.*

Trouble first arose in the vicinity of Iceland, when atmospheric conditions prevented the aircraft from communicating with the corresponding ground station. Approximately over Greenland, and ***following the instructions of the navigator****, the 707 inexplicably initiated a turn of 112 degrees, heading in a south-easterly direction towards the USSR* (our highlighting – *Auth.*). *A while later the pilot, Captain Kim Chang Kyu, sensed something was amiss by the rather obvious fact that the sun was on the wrong side of the aircraft!'*

The full truth about this incident remains unknown to this day. Some Western media maintain that the incursion was a result of crew error because the pilots were making

their first flight in an unfamiliar aircraft along an unfamiliar route. Get real. It is hard to imagine that the airline would put passengers' lives at risk by allowing such a combination – an unfamiliar aircraft *and* an unfamiliar route, which leaves the door wide open for errors. It is also hard to imagine a navigation error causing a course change in excess of 100°.

Anyway, the aircraft headed east, passing over the Spitsbergen (Svalbard) Archipelago. At 2054 hrs Moscow time the radar pickets of the 10th Independent PVO Army detected an aircraft flying at 10,000 m (32,800 ft) some 380 km (236 miles) north of Rybachiy Peninsula and heading towards Soviet territorial waters at about 900 km/h (559 mph). When the target approached the 100-km territorial waters strip, at 2111 hrs the officer of the day at the 10th Independent PVO Army command post ordered a scramble. Eight minutes later the Boeing entered Soviet airspace over the Kola Peninsula, which abounds in military installations, and was thus assumed to be a NATO reconnaissance aircraft.

Since the fighter regiment based closest to the coast was in the midst of conversion to a new aircraft type and was not operational at the time, the task of dealing with the intruder fell to the 431st IAP at Afrikanda AB (Arkhangel'sk Region), and a Su-15TM piloted by Capt. Aleksandr I. Bosov scrambled to intercept. After being directed towards the target in head-on mode by GCI control the pilot reported seeing it on his radar display, executed a port turn and started closing in on the target. Coming within visual identification range, Bosov reported it as *'a four-engined Boeing 747'* (*sic*) but said he could not make out the insignia – they were *'Japanese, Chinese or Korean'*. (Obviously the pilot had seen hieroglyphic characters of the aircraft's fuselage but had no way of knowing what language it was – *Auth.*)

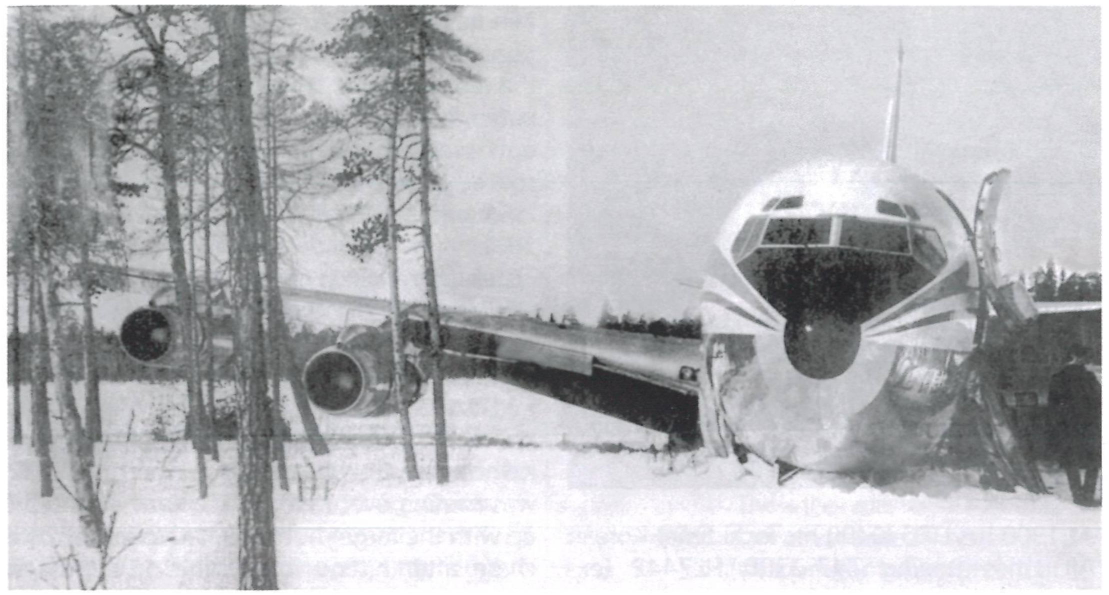
Capt. Bosov was instructed to force the intruder down at a Soviet airfield, which he tried to do, making two passes along the 707's port side 50-60 m (165-200 ft) away to a point ahead of the flight deck and rocking his wings. Yet the South Korean crew ignored these 'amorous advances' and pressed on towards the Finnish border, which was only five minutes away. (Afterwards, western media claimed that the interceptor had approached on the starboard side, in contravention of normal procedure.)

Meanwhile, after analysing the target's track plotted by AD radars, the 10th Independent PVO Army HQ decided the 707 was about to escape and ordered the airliner shot down. At 2142 hrs Bosov fired a single R-98MR missile, reporting an explosion and saying that the target was losing altitude. The explosion tore away a chunk of the Boeing's port wing 3-4 m (9 ft 10 in to 13 ft 1½ in) long complete with the low-speed aileron, knocked out the No.1 engine and apparently punctured the fuselage, causing the cabin to decompress. The crew initiated an emergency descent, causing the PVO radar pickets to briefly lose sight of the aircraft. Bosov was about to fire a second missile but lost target lock-on because the Boeing was descending rapidly; some sources claim he did fire the second R-98 but it missed.

In the meantime a steady exchange of information was going on between PVO command centres at all echelons. The PVO Commander-in-Chief was belatedly informed that the target was a civil airliner; hence the C-in-C's order not to shoot the intruder down but to force it down in one piece reached the lower echelons too late, when the 707 was already under fire. By then, apart from Bosov's

Boeing 707-321BA HL7429 at its resting place on the shore of the frozen Lake Korpijärvi.

This view shows the damage to the 707's port wing.

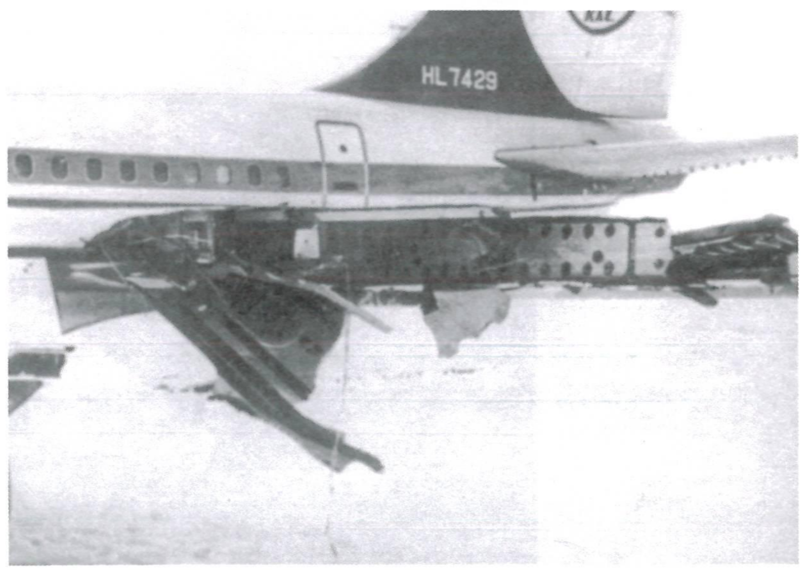


This view shows how the Boeing's undercarriage had sunk into the deep, loose snow and the starboard wing had only just avoided making contact with some pine trees on the shore.

Su-15, five other aircraft had scrambled to intercept the intruder – two 174th IAP Yak-28Ps from Monchegorsk, one 524th IAP MiG-25P from Letneozyorsk, a 265th Su-15TM from Poduzhem'ye AB piloted by Sergey Slobodchikov and a further 431st IAP Su-15TM from Afrikanda flown by Capt. Anatoliy Kerefov, which relieved Bosov's aircraft that was getting low on fuel. When the target vanished from the radarscopes, a further Yak-28P, a MiG-25P and three Su-15TMs from the same bases joined the hunt. Slobodchikov even fired a missile at a slow-flying target at 5,000 m (16,400 ft), which was believed to be a cruise missile but later turned out to be nothing more than the severed fragment of the 707's port wing falling to earth.

Meanwhile, the crippled airliner circled at low altitude near Loukhi settlement in the vicinity of Kem', Arkhangel'sk Region, where it was again detected and tracked by AD radars and the nearest interceptor was directed to the scene. Since the Su-15's radar was not much use against a low-flying target, the pilots had to spot the target visually; yet mortal men haven't got the eyesight of an owl, and even on a cloudless polar night it takes time to locate the target. At 2245 hrs Capt. Kerefov spotted the intruder flying at 800 m (2,620 ft) near Loukhi; twelve minutes later the target was spotted by a 265th IAP pilot, Maj. A. A. Ghenberg. Together they gave signals to the crew, trying to force the jet to follow them; the airliner ignored the signals, landing on the frozen Lake Korpijärvi 5 km (3.1 miles) south-west of Loukhi at 2305 hrs. Of the 109 occupants, two passengers were killed by fragments of the missile's fragmentation liner (one was killed outright and the other died en route to hospital) and 13 people were injured. The crew and passengers of the 707 were evacuated from the scene by helicopters and detained by the Soviet authorities but released two days later. They were flown by a Pan American Airlines Boeing 727-121 on a special charter flight from Murmansk-Murmashi to Helsinki-Vantaa, from where another KAL Boeing 707 took them to Seoul. KAL chose to abandon the 707 – reportedly because the costs of recovering it were considered prohibitive; the airliner was salvaged by the Soviet authorities and taken to Moscow for examination. The Soviet Union later invoiced South Korea US$100,000 in caretaking expenses.

A much more tragic incident with far-reaching political consequences occurred on the night of 31st August/1st September 1983.



Close-up of the 707's damaged port wingtip.

A Su-15TM belches afterburner flames on take-off from a Far eastern air-base.

At 1300 hrs UTC (0400 hrs local time) Korean Air Lines Boeing 747-230B HL7442 (ex-Condor Flugdienst D-ABYH, c/n 20559, f/n 186) took off from Anchorage where it had made a refuelling stop en route from New York City to Seoul on flight KE007. The aircraft was carrying 246 passengers and 23 crew and was captained on the Anchorage-Seoul leg of the journey by Chun Byung-in. According to the flight plan the aircraft was to follow the international airway R-20, which passes just 28.2 km (17.5 miles) from the Soviet (Russian) border at the closest point, and proceed straight ahead until it passed Hokkaido Island, whereupon it would turn to starboard in a wide arc towards Seoul. However, just ten minutes after take-off HL7442 deviated to the right, assuming a heading of 245° instead of the required 220°, and strayed from its designated airway; the deviation steadily increased until presently the aircraft entered Soviet airspace near the Kamchatka Peninsula. For 2.5 hours the 747 flew illegally over a piece of Soviet territory packed with sensitive military installations (which makes its flight number an apt one, indeed). Of course it was immediately assumed to be a spyplane, and orders were given to intercept the intruder.

First, a MiG-23P piloted by Maj. Vasiliy Kaz'min scrambled from Petropavlovsk-Kamchatskiy/Yelizovo airport when the 747 was passing over Kamchatka. Kaz'min caught up with the target but soon had to give up the chase after hitting 'bingo fuel'. The reason was that after Belenko's defection the top command distrusted the 'grass roots', and the fighters were filled up with just so much fuel as to make a defection impossible! No one seemed to realise, or care, that this jeopardised the PVO units' ability to fulfil their mission and that one bad egg does not automatically mean that the whole box of eggs is bad.

Anyway, the 747 had left Soviet airspace for a while as it continued in a straight line over the Sea of Okhotsk. However, its course was bound to take it into Soviet airspace again over Sakhalin Island. By then the Soviet PVO

A pilot climbs into a Su-15TM standing on QRA duty.

system was in turmoil and orders had been issued to shoot the aircraft down, should it intrude again – which it did at 1816 hrs UTC, being assigned the code 'target 6065'. By then the aircraft was 500 km (310 miles) west of the desired track. At 1742 hrs and 1754 hrs UTC (0542 hrs and 0554 hrs local time) two 365th IAP Su-15TMs scrambled from Sokol AB near Dolinsk in the south of Sakhalin Island; the fighters were armed with a pair of R-98 missiles and a pair of UPK-23-250 cannon pods each. One of the Su-15s, piloted by Maj. Ghennadiy N. Osipovich, intercepted the airliner, which was cruising at 11,000 m (36,090 ft); some sources, though, report the flight level as 9,000 m (29,530 ft). Osipovich tried to contact the crew by radio and fired warning shots from his cannons, ordering it to land. However, the cannon shells were not tracers, and the Korean pilots failed to notice them.

Since the intruder ignored all calls and pressed on towards the border, orders were given to destroy it. At 1826 hrs UTC Osipovich fired both of his missiles, which found their mark, damaging the hydraulics and the control system (contrary to some reports, the aircraft did *not* break up in mid-air). After climbing briefly to 11,600 m (38,060 ft) the 747 suffered a total decompression and began a spiral descent; at 1838 hrs the jet vanished from the radarscopes at 5,000 m (16,400 ft). Moments later it plunged into the Sea of Japan off Moneron Island, disintegrating on impact and killing all 269 occupants.

The reader may be interested to know how this mission proceeded. The following is a transcript of the radio exchange between Lt.-Col. Titovnin at the PVO division's command centre (**CC**, callsign *Deputat* – '[People's] Deputy' or 'Member of Parliament') and pilot Maj. Osipovich (**P**, callsign '805'). Intermissions by the following people are also included: Gen. Valeriy Kamenskiy, Commander of Far East Military District Air Defence Force (**VK**); Gen. Anatoliy M. Kornukov, Commander of the 40th IAD (**AK**); Lt.-Col. Gerasimenko, acting CO of the fighter regiment at Sokol AB (**G**); Lt.-Col. Maistrenko, officer of the day at the 24th PVO Division HQ (**M**); and Kozlov (rank unknown), Combat Controller at Sokol AB (**K**).

P: *Deputat, 805 here, I'm on heading 45°, climbing to eight* (8,000 m/26,250 ft – *Auth.*).
CC: *805, roger, stay on this heading.*
P: *Copy that.*

05:56 CC: *805, Deputat here, the target is 5 [degrees] to port, range 130 [km/80.75 miles]. Target follows a heading of 240°, 5 [degrees] to port, range 120 [km/74.5 miles].*
05:58 CC: *805, Deputat here, target straight ahead, range 70 [km/43.5 miles], flight level 10,000 [m/32,800 ft].*
06:02 P: *Target in sight, flying at 8,000.*
06:03 CC: *Roger, target straight ahead, range 12-15 km [7.5-9.3 miles].*
06:04 CC: *805, Deputat here, target coded hostile, to be destroyed in the event of an incursion.* (This is the order to fire – *Auth.*). *Activate the special system* (weapons control system – that is, arm your weapons – *Auth.*).
P: *Roger, wilco.*
CC: *805, can you identify the aircraft type?* (This query and the reply are noteworthy – *Auth.*).
P: *Not quite. It's got flashing lights.*
CC: *805, interrogate the target* (by means of IFF – *Auth.*).

(Osipovich tries but gets no response, of course.)

CC (to Kornukov): *No response.*
AK: *Well, that makes it clear, then. Prepare to use the weapons.*
P: *Roger.*
06:05:56 P: *Target in sight.*
06:08 K: (to Kornukov) *He has the target in sight.*
AK: *Oh, has he? How many contrails is it leaving?*
K: *Say again.*
AK: *How many contrails are there? If there are four, then it is an RC-135.*
06:11 CC: *Can you see the target, 805?*
P: *Affirmative, I have it both within eyesight and on the radar screen.*
CC: *Roger. Report when you have lock-on.*
06:12 AK: *Gerasimenko!*
G: *Yes, sir!*
AK: *Well? Haven't you got it? I said, bring him within a range of 4-5 km [2.5-3.1 miles], identify the target. You understand that weapons will have to be used now, and you are holding [him] at a range of 10 [km/6.2 miles]. Give the pilot [his] orders.*
G: *Yes.*

06:13:05 P: *I see it* (the target – *Auth.*). *I have lock-on.*

06:13 AK: *[Put me through to] 'Chaika'* (Seagull, the callsign of the Far East MD PVO HQ – *Auth.*).

CC: *Yes, sir. He sees [the target] on the radar screen. He is locked on.*

06:13.26 P: *No ['friendly' IFF] response.*

CC: *805, is the target's heading 240°?*

P: *Affirmative. The target's heading is 240°.*

CC: *Roger. Activate the special system.*

P: *System active.*

CC: *805, Deputat here, keep an eye on the target's heading.*

P: *Roger, so far it maintains the same heading.*

06:14 AK (on the phone): *Comrade General Kamenskiy, good morning. I am reporting the situation. Target 6065 is over Terpeniye Bay* ('Patience Bay', on the east coast of Sakhalin – *Auth.*), *tracking 240, 30 km [18.6 miles] from the State border. The fighter from Sokol is 6 km [3.73 miles] away. Locked on, orders were given to arm weapons. The target is not responding to IFF. [The fighter pilot] cannot identify it visually because it's still dark, but he's still locked on.*

VK: *We must find out, it could be some civilian aircraft or God knows who.*

AK: *What civilian?! [It] has flown over Kamchatka! It came from the ocean without identification. I am giving the order to attack if it crosses the border.*

CC: *805, Deputat here, get ready to fire, get ready.*

P: *Roger. I'll need to use afterburners.*

CC: *What's your fuel status?*

P: *I got 2,700 [kg/5,950 lb].*

CC: *Engage afterburners when ordered.*

06:15 CC (on the phone): *[Put me through to] Maistrenko. ...Comrade Colonel, Titovnin speaking.*

M: *Yes.*

CC: *The commander has given orders to destroy [the target] if it breaches the border.*

M: *...It may be a passenger [aircraft]. All necessary steps must be taken to identify it.*

CC: *Identification measures are being taken, but the pilot cannot see. It's dark. Even now it's still dark.*

M: *Well, OK. The task is correct. If there are no [navigation/strobe] lights, it cannot be a passenger [aircraft].*

06:16 CC: *805, do you have a good lock-on?*

P: *I got a stable lock-on.*

06:17 CC: *Do you see the adversary?*

P: *Target in sight.*

CC: *Roger. Destroy!*

P: *Say again.*

06:18 CC: *805, the target has breached the State border. Destroy the target!*

P: *Roger, wilco.*

CC: *Does the target have the navigation lights switched on?*

P: *Affirmative, the navigation lights are on... a flashing beacon is on.*

CC: *Roger.*

06:19 CC: *805, flash your nav lights.*

CC: 805, *turn on your navigation lights briefly.*

CC: *805, force the target to land at our airfield!* (This order overrules the one to destroy the target – *Auth.*).

P: *...I got my missile launch indicators on!*

CC: *805...?*

P: *805 here.*

06:20 CC: *805, fire a warning shot! Give a cannon blast!*

P: *I have to move in closer. I'm cancelling lock-on, moving in.*

CC: *Give a cannon blast!*

CC: *805! Comply!*

P: *Lock-on cancelled, I'm firing the cannons.*

CC: *Have you fired, 805?*

P: *Affirmative.*

CC: *Do you see the target?*

06:21.35 P: *Yes, I'm closing in.*

CC: *Roger.*

P: *The target's strobe light is flashing. I'm within 2 km [1.25 miles] or so.*

CC: *Is the target descending?*

06:21.40 P: *Negative, it is still flying at 10,000 [m/32,810 ft].*

P2: (a 777th IAP MiG-23P pilot from Smirnykh AB, callsign '163'): *I see you both, about 10-15 km [6.2-9.3 miles] out.*

06:21.55 P: *Request further instructions.*

06:22.02 P: *The target is decelerating.*

06:22.17 P: *I'm passing it... passing... I'm ahead of it now.*

CC: *Roger, 805. Reduce speed, 805. Flash your nav lights.*

06:22.23 P: *Roger, wilco. Speeding up now.*

CC: *Has the target speeded up?*

06:22.29 P: *Negative, it is reducing speed.*

CC: *805, engage the target!*

06:22.42 P: *I cannot! You should have told me earlier... I'm abreast of the target now.*

CC: *Roger. Move into attack position if you can.*

06:22.55 P: *I'll have to fall back now.*

06:21–22 AK: *Gerasimenko, cut the horseplay at the command post! What is that noise there? I repeat the combat task: fire missiles, engage target 6065.*

G: *Roger, wilco.*

AK: *Comply, and get Tarasov here* (the MiG pilot? – *Auth.*). *Take control of the MiG-23 from Smirnykh [AB], call sign 163; he is behind the target at the moment. Destroy the target!*

G: *Copy that. Destroy target 6065 with missile fire, accept control of the fighter from Smirnykh.*

AK: *Carry out the task, destroy!*

06:22:55 AK: *Aagh, [censored], how long does it take him to get into attack position? He is already exiting into international waters! Engage afterburner immediately. Bring in the MiG-23, too... While you are wasting time it* (the intruder – *Auth.*) *will get away.*

CC: *805, try to destroy the target with cannon fire.*

CC: *Report relative target position, 805.*

P: *Say again, please!*

CC: *What is the target's altitude?*

P: *10,000.*

CC: *What's the relative target position? Relative to you?*

P: *Relative target position? Let me see... 70° to port.*

CC: *Roger.*

06:23 CC: *805, try to destroy the target with cannon fire.*

06:23.37 P: *I'm falling back now, I'll try missiles.*

06:23.37 CC: *Roger.*

06:23.37 P2: *Target 12 km [7.46 miles] out. I see you both.*

CC: *805, approach the target, destroy the target!*

06:24.22 P: *Roger, wilco. I have a good lock-on.*

06:24.22 CC: *805, are you closing in?*

06:25.11 P: *Target ahead, I have lock-on, range 8 [km/5 miles].*

06:25.11 CC: *Engage afterburners! Afterburners, 805!*

06:25.16 P: *'Burners on.*

06:25.16 CC: *Fire!*

06:25.46 P: *Missiles locked on.*

(Here, an error occurring in previous interpretations of the transcripts must be set straight. The code phrase 'ZG' occurring in the radio communications means *za**khvaht** go**lov**ok* [***sa**mon-ave**den**iya*] – 'missile seeker heads locked on', not *za**pahs** go**ryu**chevo* – fuel quantity, that is, 'bingo fuel', as claimed! – *Auth.*).

06:26.02 (Missile detonates)

06:26.20 P: *Missiles fired.*

06:26 AK: *Well, what news from out there?*

G: *He has launched [the missiles].*

AK: *Say again.*

G: *He has launched.*

AK: *So he has launched. Track the target, track the target, tell your [fighter] to disengage and bring the MiG-23 in there.*

06:26.22 P: *Target destroyed.* (Which in reality it was not. – *Auth.*)

06:26.22 CC: *Break off the attack, turn right on heading 75°.* (Some reports state 360° – *Auth.*)

06:26.27 P: *Attack interrupted.*

06:26:33 P2: *Request further instructions.*

06:26:47 P2: *My wing tanks* (that is, 'wing tanks empty' warning lights – *Auth.*) *have lit up. The fuel remainder differs by 600 litres [132 Imp gal] for now.*

06:26:53 P *Fuel remaining 1,600 [kg / 3,530 lb].*

As the reader has probably realised, neither the ground controller at the PVO command centre nor the pilot were able to identify the aircraft they attacked with absolute certainty

because the incident took place at night. (However, even in less than total darkness the Boeing 747 is easy to identify by its unmistakable humpbacked silhouette.)

When the Soviet commanders became aware that the 747 was not destroyed in spite of the missile attack, pandemonium began. Lt.-Col Novoseletskiy, the acting CO of the fighter regiment at Smirnykh AB (**N**), queried: *'Well, what is happening, what's the matter? Who guided him in?* (referring to Osipovich – *Auth.*) *He locked on, why didn't he shoot it down?'* Meanwhile, the MiG-23P flying at 7,500 m (24,600 ft) was ordered to turn onto a heading of 180° and then 150°.

06:27 AK: *Did Osipovich see the missiles explode? Hello...?*
G: *He fired two missiles.*
AK: *Ask him, ask him personally, get on channel three and ask Osipovich if he saw the explosions or not?*
G: (to Kornukov) *Right away.* (to Osipovich) *805, did you launch one missile or both?*
06:28:05 P: *I launched both.*

(At this point, the MiG-23 pilot was ordered to turn onto a heading of 210° and climb to 8,000 m (26,250 ft).

06:28 G: *The target has turned north.*
AK: *?! Has the target turned north?*
G: *Affirmative.*
AK: *Bring in the [MiG-]23 to destroy it!*
06:29 AK: *I do not understand the result. Why is the target flying? Missiles have been fired; why the [censored] is the target still flying? You are executing orders like a blankety-blank ninny! The orders of [Army General] Ivan Moiseyevich Tret'yak* (the Commander of the Far East MD – *Auth.*) *shall be carried out at any cost! God forbid Osipovich screwed up!... Finish off the target, finish it off! [censored]*
AK: *...Well? I am asking, give the order to the controller, what's wrong with you there? Have you lost your tongues?*
G: *I gave the order to the Chief of Staff, the CofS [passed it on] to the controller, and the controller is giving the order to...*
06:30 AK: *Well then, how long does it take for this information to get through?! Are you telling me you cannot ask for the results of the missile launch, where, what, did [Osipovich] not understand or what?*

Meanwhile, unable to see the target, the MiG-23 pilot was given a new heading of 360°

06:32–33 AK: *Altitude, what is the flight level of our fighter and of the target?... Quick, give me the flight levels of the target and of the fighter!... Why are you silent?... Gerasimenko!*
G: *I am asking [the pilot]...*
AK: *Hurry up, guys, that's a real target!*
06:33/34 G: *The target is at 5,000 [m/16,400 ft].*
AK: *?! 5,000 already? [That low?!]*
G: *Affirmative, turning left and right, apparently descending.*
06:34 AK: *Destroy it, use the [MiG-]23 to destroy it, I said!*
G: *Roger, destroy it.*
AK: *Well, where is the fighter, how far from the target?*
G: *Comrade General, they cannot see the target.*
AK: *They cannot see the target?*
06:35:54 P3 (yet another MiG-23 pilot, callsign 121): *Negative, I don't see it.*
06:36 AK: *...you know the range, you know where the target is. It is over Moneron...*
06:38:37 P3: *I cannot see anything in this area. I just looked.*
06:38 N: *Well, what news, Titovnin?*
CC: *Er, none so far.*
N: *What's the matter? The pilot had lock-on, why isn't the target shot down?*
CC: *They lost the target, Comrade Colonel, near Moneron.*
N: *In the area of Moneron?*
CC: *The pilots do not see it, neither the first one nor the other one. The radar troops have reported [...] that after the launch, the target began a right turn over Moneron.*
N: *Uh-huh.*

CC: *Descending. And lost over Moneron.*

With fuel running low, the Soviet fighters return to base without sighting the remains of their target.

06:39 N: *So, the task. They say it has violated the State border again, now?*
CC: *Well, it is near Moneron, of course it is our territory.*
N: *Nail it, nail it! Come on, bring in the MiG-23.*
CC: *Roger. The MiG-23 is in the area. It is descending to 5,000. The orders have been given: shoot on sight.*
06:40:11 P3 *I'm unable to determine the cloudbase. The clouds are below me and I'm at 2,000 [m/6,560 ft].*
06:41 AK: *Well, what's going on? Has the [MiG-]23 reported anything, does he see [the target] or not? Bring him down to 4,000 [m/13,120 ft]. Have him look visually and on the radar.*

After that, a search and rescue effort was initiated, with SAR helicopters, KGB Border Guards patrol boats and civilian ships in the area being sent to the 747's presumed crash site. All the while where was a good deal of exchange going on, richly laced with bad language that even the intelligence specialists at the listening posts had trouble translating!

...Many years later, after spinal injuries sustained in a not entirely successful ejection during a positioning flight had forced him to retire from active duty, Ghennadiy N. Osipovich was interviewed at his home by a correspondent of the Russian daily *Izvestiya*. The following are his reminiscences on the shootdown.

'On 31st August I assumed combat duty as usual. [...] I reported "upstairs", had dinner with the other pilots on QRA duty, then watched TV for a while and dozed off. I woke up at about half past four (local time – *Auth.*) *to check the guard posts. No sooner had I dressed when the telephone jangled. It was Lt. Astakhov; at first I could not make out what he was mumbling but presently gathered that I had been assigned maximum readiness, which means sitting in the cockpit and awaiting the order to scramble.*

I made my way to the hardstand, wondering, "Why me? There is already a young pilot sitting at maximum readiness." Still, I quickly climbed into my fighter, reported to the tower and received confirmation – "be ready to scramble". Time passed, and no new orders were forthcoming. Suddenly I saw the ground crew removing the wraps from one more aircraft. "What's up?" – I thought. It was a bit early for the Americans; usually they grew active after 11 o'clock.

Shortly after five o' clock I was, at length, ordered to take off. I started the engine (*sic*; the Su-15 is twin-engined – *Auth.*), *switched on the landing light – the runway was not yet illuminated – and taxied out. My assigned heading took me over the sea. I quickly climbed to the required 8,000 m [13,120 ft]*

Su-15TM '38 Yellow' carrying R-98 missiles and UPK-23-250 cannon pods is in the same configuration as Osipovich's aircraft was on the night of the shootdown.

365th IAP Su-15TM '17 Red' – the aircraft in which Ghennadiy Osipovich shot down the Korean Boeing 747 on 1st September 1983

and ambled on. For some reason I was certain that it was a practice target launched by our own forces to check the readiness of our QRA assets, just for the sake of practice. And I had been ordered up because I was the most experienced pilot, I reasoned.

Eight minutes into the mission, the ground controller suddenly radioed: "Target straight ahead! It's an aircraft breaking the flight rules. It is moving on a reciprocal heading." However, the guidance system failed to work in head-on mode for some reason. Soon I received new instructions: "We'll guide you in pursuit mode".

Well then, so be it. I made a U-turn and, having received an altitude update, set off in pursuit of the intruder. The weather was fair that day. Soon I had spotted the intruding aircraft through the scattered cloud. Actually, what I mean by saying "spotted" is that I could make out a dark dot, 2-3 cm [$0\frac{25}{32}$ to $1\frac{3}{16}$ in] large, flying ahead of me. It had operating anti-collision beacons.'

When asked what exactly he was thinking of at that moment, Osipovich replied: *'Nothing much. It was pure excitement, an adrenalin rush! Afterwards, I was unable to put together a second-by-second reconstruction of what was happening up there, no matter how they wanted me to.'*

He went on: *'A fighter pilot is, sort of, like a watchdog that is perpetually trained to keep strangers off the territory it is guarding. And that's exactly what it was, the aircraft in front of me – a stranger. After all, I'm not a traffic cop who can pull over a speeding driver and demand his licence and registration! I was following him in order to cut his flight short. The first thing I had to do was to try and get him to land. Failing that, I was to put him out of action at any cost. I could not possibly have any other thoughts in my head [then]. Anything else I heard later about what I might have been thinking is poetic licence. Not more.*

Anyway, I approached [the intruder] and got a radar lock-on. Immediately the missile seeker heads' lock-on indicator lights lit up.

The 'bogey' was doing about 1,000 km/h [621 mph]. I was going faster and had to equalise our speeds. Tagging along 13 km [8.08 miles] behind it, I reported: "I have lock-on. I am following the target. Awaiting further instructions."

A 57th GvIAP Su-15TM coded '04 Blue' comes in to land at Noril'sk-Alykel' airport where it was based.

Then, however, the GCI guidance officer started asking me for the target's heading, flight level etc.; this was a reversal of the normal situation – he should be telling me that! Only later did I learn that both of us (the target and I) had entered a "blind spot" (in the radar coverage – *Auth.*) *that had been completely unknown.*

"For a while we could see neither you nor him [on the radarscopes]", the guidance officer told me when I had landed.

Presently we approached Sakhalin. Then the GCI guidance officer gave the order to engage:

"The target has breached the State border. Destroy the target!"

I engaged the afterburners; the missile seeker heads' lock-on indicator lights started flashing (suggesting that lock-on was unstable – *Auth.*). *Suddenly the controller's voice came through the headset:*

"Abort engagement! Climb to the target's level and force it to land!"

At that point I was approaching the target from below. Well, I equalised our speeds and started flashing [my navigation lights]. Yet he showed no reaction.

"Give a warning burst of cannon fire!" – ground control ordered. I fired four bursts, expending more than 200 rounds. Little good did it do; my cannons were loaded with armour-piercing rounds, not incendiary ones (*sic*; 'traced' would be more appropriate – *Auth.*). *Hardly anyone could see them at all.'*

'But, wait a minute, there have been reports in our (Soviet – *Auth.*) *newspapers quoting "official sources" that you had fired warning shots, using exactly incendiary – or traced – rounds!'* – the interviewer chimed in.

'That's not true. I had no such ammo. Therefore I used what I had – AP rounds.'

'But in that case the pilots of the 747 obviously could not see you – which is what foreign experts maintain.'

'I disagree with that, – Osipovich countered. – *I have no doubt that they did notice me. The pilots' reaction was unambiguous – they soon reduced speed to approximately 400 km/h [248.5 mph]. Now, 400 was below my minimum control speed – I could not fly that slowly. I believe the intruder counted on that I would have to overshoot in order to avoid a stall. This is exactly what happened.'* (Western sources state that at that point the pilots of the 747 had initiated a climb as commanded by the Tokyo ATC centre in order to conserve fuel, which accounts for the deceleration, but concede that the deceleration was

This Su-15TM has a full complement of missiles, with R-60Ms on the inboard wing pylons.

obviously interpreted by Osipovich as an evasive manoeuvre to shake off the interceptor – *Auth.*) *'We were already above [Sakhalin] island, which is narrow in the location where we were. The target was on the point of getting away. Just then, a new command from GCI came in:*

"Destroy the target!"

It was all very well for them to say "destroy". But how was I supposed to do it? With cannon fire?! But I had already used up 243 rounds. Ram it? I have never been enthusiastic about that kind of thing. A ramming attack is the last resort. I even had time to work out that scenario: I would climb higher than the intruder and "mount" him. But then it occurred to me that I had "fallen through" to a point 2,000 m [6,560] ft below [the target's flight level]. I engaged the afterburners, armed the missiles and tried raising the fighter's nose. It worked! I saw that I had a lock-on.

Maj. Ghennadiy N. Osipovich (centre) with his buddies.

The first missile left the pylon when the target was 5 km [3.1 miles] away. Only then did I have a chance to get a good look at the intruder. The aircraft was larger than the IL-76 [transport] but was similar in proportions to the Tu-16 [medium bomber]. The trouble with all Soviet pilots is that we do not study the commercial aircraft operated by foreign air carriers (for identification purposes – *Auth.*). *I knew what all the military aircraft looked like, all the spyplanes... but this one was not similar to any of them.'*

When asked if he had any doubts then as to whether his actions were correct and legal, Osipovich said: *'It did not occur to me for one minute that I might be attacking an airliner. It could be anything, I thought, but not [an airliner]. How could I suppose I was chasing a Boeing?'* (In this case, Osipovich uses the name Boeing synonymously with the products of the Boeing Commercial Airplane Group – *Auth.*) *'What I had before me was a large aircraft with navigation lights and anti-collision beacons switched on.*

The first missile went for the tail section. A yellow flame erupted. The second missile took off half the jet's port wing. The navigation lights and anti-collision beacons went out immediately.' (Here, Osipovich is mistaken; the wing did not break up – otherwise the stricken 747 would not have been able to glide all the way to Moneron Island – *Auth.*)

'All the while there was a tremendous hubbub on the communications channels. I remember that a MiG-23 was following me; it was carrying drop tanks and therefore unable to fly fast. Well, the MiG pilot kept yelling all the while: "I see an aerial battle!" What battle could he possibly see?! I am at a loss to explain. But then, after the bogey's lights went out and I broke right, I heard on the radio that the MiG was being vectored towards the target for some reason. "The target is descending", the guidance officer radioed. The MiG pilot hollered: "Can't see it!" Again, he was given instructions: "Target descending through 5,000 m [16,400 ft]". Again, he replied: "Can't see it!" Then, all at once, the call went out: "The target has vanished from the radar display". I remember thinking then that the target had proved hard to kill. Later, I was told that it was pure (mis)chance that the Boeing had been downed by just two missiles; normally it would take at least seven AAMs of the type carried by my Su-15.

On the return leg I checked my instruments. I had "bingo fuel" – just enough left for ten minutes' flight. And mind you that I had to fly 150 km [93 miles] to reach my base – and, in keeping with Murphy's Law, the base had been obscured by fog coming from the sea. Yet somehow I managed to land safely.'

'What was the reception back at the base?' – the interviewer asked.

'I was given a hero's welcome. The entire personnel of the regiment lined up to greet me! The greenhorn pilots eyed me with open envy, while the seasoned ones stated that now I would have to furnish a bottle of drink to celebrate the "kill". I remember the regiment's Chief of Maintenance giving me a bear hug, shaking my hand and shouting: "It worked! Good for you!" In a nutshell, there was jubilation: shooting down a real intruder is not an everyday occurrence. Well, actually, after landing I started to feel uneasy. So, when the division CO Col. Kornukov phoned me, I asked if, by any chance, the target had been a "friendly" – just to be on the safe side. "No way, – Kornukov replied. – It was a foreign aircraft, so you might as well begin drilling holes in your shoulder-pieces for new stars" (that is, prepare for a promotion – *Auth.*).

'All of this was on the morning of 1st September.

Next thing, however, all hell broke loose. An investigative commission arrived. All at one everyone started treating me like the worst son-of-a-bitch – except my buddies in the regiment, of course.

"Did you know there were 260 (sic – *Auth.*) *passengers aboard?" I was asked this question many times afterwards. Later, I replayed the mission in my head time and time again. And I can tell you perfectly honestly: I had no idea that the aircraft in front of me was a civil airliner. What I was seeing then was a hostile aircraft that had breached the border; ergo, exterminate! During my active years as an interceptor pilot I had flown intercept missions many times, and I actually wanted a real-life intercept. I knew that if a bogey should come my way I would not let it escape. A couple of years earlier I even had a dream of an intercept that was quite similar to what actually happened. This is the interceptor pilot's main quality, if you like – not to let the intruder get away.*

I'd like to reiterate: all talk of the target being a civil airliner did not come until later. Up there, in the air, I was up against an intruder. I remember my radio communications with the ground by heart; and here, you have them, too. There is not the remotest hint in the wording that there could be passengers inside that aircraft.'

Here, a Su-15TM streams its twin brake parachutes immediately after touchdown at a Far Eastern airbase with characteristic hills in the background.

Still, Osipovich had his share of problems during the investigation. He commented on this as follows: *'In our country, there are lots of people who want to play safe and protect their asses. The military is no exception. Now, consider a high-profile scandal like this! I had heard that when one of our pilots shot down an American RB-47 during the Khrushchov era, he was thrown in the slammer at first. He was only released when the situation was clarified. ...In my case, everyone was waiting for the decision of the Powers That Be. Therefore I was ready for any outcome. Soon, however, Minister of Defence [Marshal Dmitriy F.] Ustinov phoned [my commanders] – and all at once I was back in from the cold, as if orders had been given! A camera crew and a reporter from the Soviet Central Television flew in at once to interview me. They were really pissed off: they had been scheduled to go to Cuba, and I – that is, my shooting down the Boeing – ruined all their plans. I was given a "libretto" of my TV interview, all duly approved by the higher command. I had to know it by heart. However, when I started rattling off the text, Aleksandr Tokhomirov, the cameraman, pulled a wry face and said: that's no good, we need improvisation. I asked for a short time-out. I went to the TV tech crew, downed a shot of vodka and started playing it by ear – talking about a "peace lesson"* (a widespread propaganda exercise in Soviet times – *Auth.*), *about the nuclear bomb etc, etc. Today, I wouldn't manage to speak so cleanly.*

Speaking of over-cautious people and this TV interview "libretto", I was surprised by the

57th GvIAP *Flagon-Fs* on the military apron at Noril'sk-Alykel'.

lack of dignity on the part of some of our top brass. Even now, I have no doubts that we were acting correctly. For 2.5 hours an intruder was plying our airspace, covering a distance of more than 2,000 km [1,242 miles]. All the foreign ATC services were keeping mum all the while (not alerting the crew of the deviation – *Auth.*). *What were we supposed to do? Sit back and wait? The shootdown was legitimate. Later, however, we started lying when it came to the details; we started claiming that the aircraft was flying with the navigation and anti-collision lights turned off, that I had contacted (or tried to contact) the crew on the 121.5 MHz emergency frequency... I simply did not have time to do that* (contact the Korean crew – *Auth.*)! *Please understand that in order to do it I would have had to switch channels and hence lose radio contact with my own command centre. I am convinced that we wanted to emerge victorious from the situation and ended up overdoing it, as a result...*

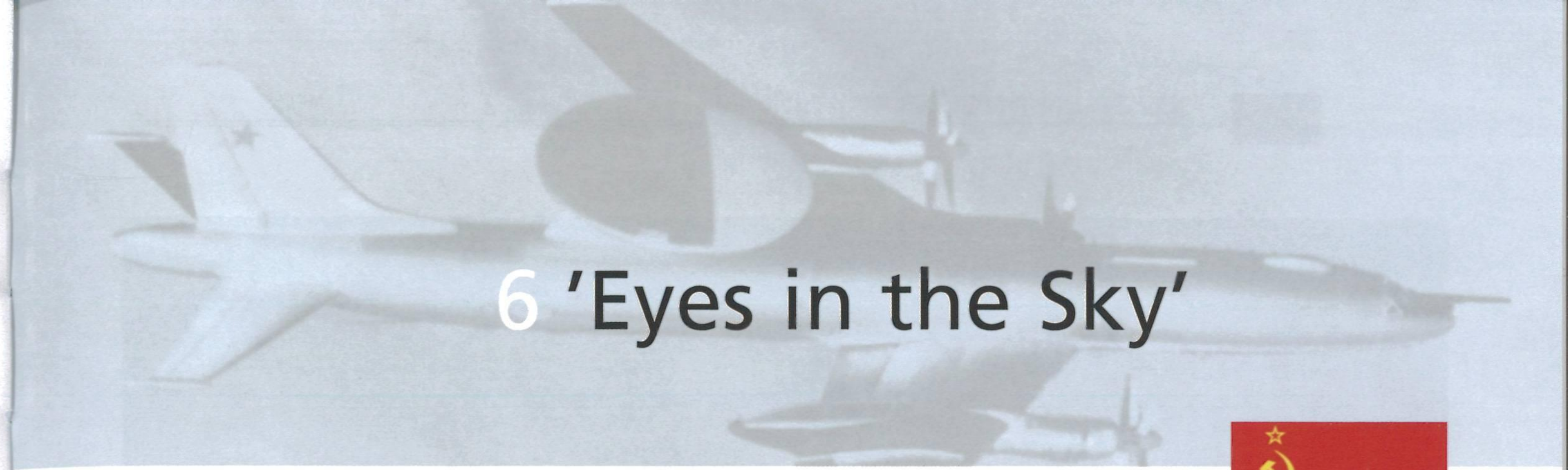
As for me personally, I was carrying out my duty until the end. And should I be in a similar situation again – unless it was a civil airliner with passengers aboard, of course! – I would do whatever it takes to stop the intruder. That's the way I had been brought up and trained, all my life.

[...] Back then on Sakhalin, I had heard that the [wreckage of the] Boeing had been found and even examined. But they found no bodies in there. They say there are extraordinarily voracious crabs in the sea near Sakhalin that devoured the bodies in a twinkling... From what I've heard the divers found only a human hand in a black glove – perhaps it was the pilot's hand... You know, even now I am doubtful if there were really passengers aboard that Boeing. You can't blame it all on the crabs – there should have been some bodies remaining. I still support the original view – this was a premeditated spy mission. In any case, the Boeing did not turn up there accidentally.'

Even today, debate continues as to what the KAL jumbo was doing for 2.5 hours in a place where it should not have been at all. Was it on a premeditated spy mission, as the Soviet government has always maintained, or was the incursion really a result of a navigation error? There are several possible explanations to support both theories. Quite apart from the escalation of the Cold War under the Reagan administration, the spy mission theory is backed by the fact that a USAF/55th SRW Boeing RC-135 ELINT aircraft (designated as target 6064 by the PVO command post) was loitering at 8,000 m (26,250 ft) over the Bering Sea near Karaginskiy Gulf on the north-eastern coast of Kamchatka at the time of the incident – reportedly to pick up telemetry during a scheduled Soviet ballistic missile test. For a while the two Boeings were so close that, in the opinion of some sources commenting on the shootdown, the Soviet AD radar operators may have mixed them up and tracked the 747 in the belief that it was the RC-135. It may be that the 747's mission was to provoke the Soviet air defence assets into revealing themselves – for the benefit of the RC-135. Also, the 747 was tracked by several civilian ATC radars and the US military radar at King Salmon Island, Alaska; yet none of them alerted the crew of the steadily increasing divergence. Since the flight had originated on US soil and American nationals were among the victims, the National Transportation Safety Board began an investigation; however, the Reagan administration closed it down (on the pretext that it was not an accident) and turned over the investigation to the State Department which, in turn, deferred it to the International Civil Aviation Organisation. The latter, unlike the NTSB, had no power to subpoena any politically or militarily sensitive information that might embarrass the Reagan administration or contradict its version of the events.

The navigation error theory is based on the fact that the use of the inertial navigation system (INS), with the aircraft following a pre-programmed route with waypoints, is required for the (mostly) overwater leg between Anchorage and Seoul, as the aircraft would be out of range of ground navigation beacons most of the time. It is based on the assumption that either the 747's crew had programmed the INS incorrectly at Anchorage, or the INS failed to activate because the aircraft was already too far off the designated track. Thus the autopilot remained in heading hold mode, and the crew did not recognise the problem; in fact, they never realised they were off course.

The incident provoked a huge public outcry and a wild anti-Soviet campaign led by the USA, with political battles in the United Nations Security Council. A major search effort was made by both the Soviet Union and the USA jointly with South Korea; several investigations of the incident were also undertaken. Moreover, various alternative theories of the Flight KE007 story appeared, including some which were pure fiction. However, this is a major topic which lies outside the scope of this book.



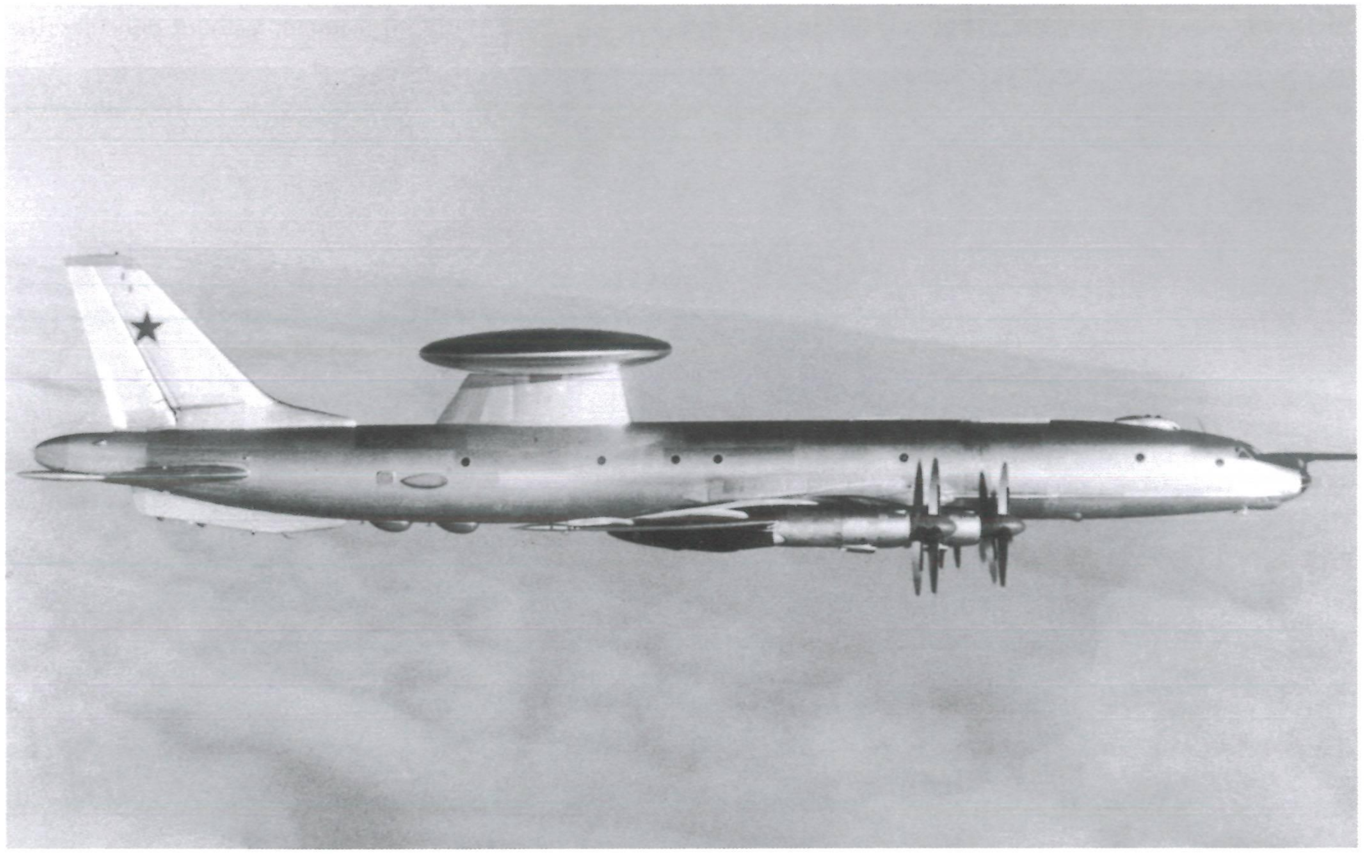
6 'Eyes in the Sky'

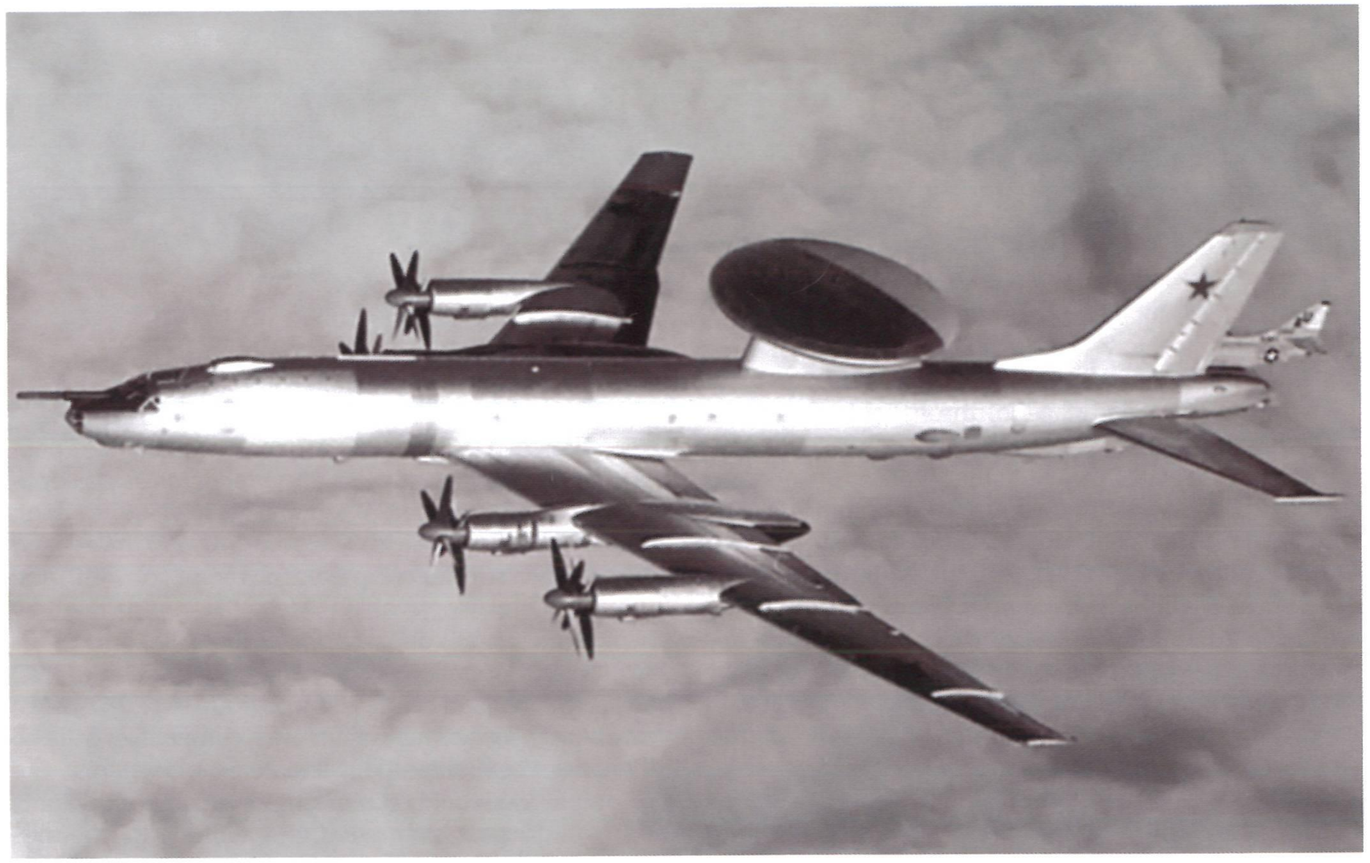
The Soviet political and military leaders were aware of the strengths and flaws of the nation's air defence system. For many years the northern reaches of the Soviet Union were lacking in fighter protection and radar coverage; building and operating airbases and AD radar systems in those inhospitable parts was a problem. Therefore, the PVO needed airborne early warning and control (AEW&C) systems that could patrol the Arctic regions and be deployed elsewhere as required. The first attempts to bridge the capability gap with the West in this area were made in the late 1950s.

Tupolev Tu-126 (*izdeliye* L, *Moss*)

On 4th July 1958 the Soviet Council of Ministers issued a directive tasking the Tupolev OKB with creating an AEW&C system. The aircraft was to utilise the newly-developed *Liana* (Creeper) radar and communications suite that had been created by the Moscow Research Institute of Instrument Engineering (NII-17, or NIIP – *Naochno-issledovatel'skiy institoot priborostroyeniya*) under General Designer V. P. Ivanov. The Liana had phenomenal performance by the day's standards; it was optimised to detect airborne targets at medium to high altitudes at a range of 100-350 km (62-217 miles) and cruiser-sized surface ships at a range of 400 km (248 miles). It was also able to detect being 'painted' by enemy radars at distances of 500-600 km (310-372 miles). Information could then be transmitted to PVO and Navy command centres up to 2,000 km (1,242 miles) away. Additionally, the system was compatible with all other Soviet communications and detection systems.

The mission would require long-duration patrol flights lasting 10-12 hours or more. Cruise altitude for the mission was to be between 8,000 and 12,000 m (26,250-39,360 ft). Detection range in the upper hemisphere (using line-of-sight computation) was to be 100 km (62 miles) for aircraft the size of the MiG-17 fighter,





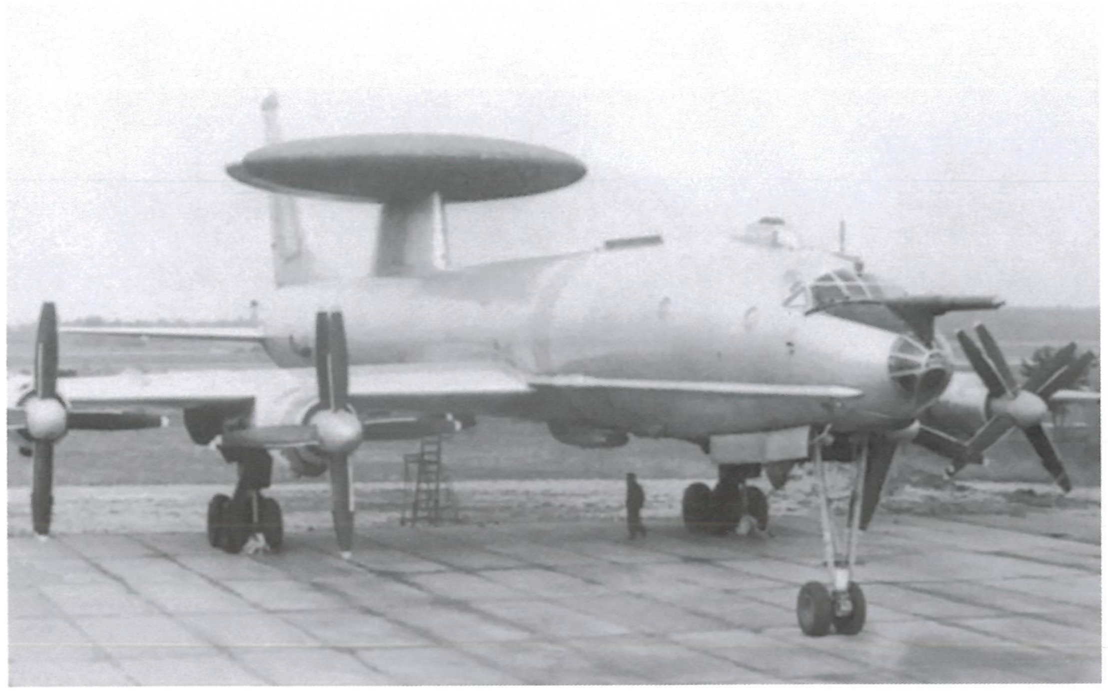
A Tu-126 chased by Douglas A-4E Skyhawk BuNo 152012/'AU-662' of VFS-1 from USS *Yorktown*.

200 km (124 miles) for aircraft the size of the IL-28 tactical bomber and 300 km (186 miles) for aircraft the size of the Myasishchev M-4 strategic bomber. Look-down detection range was limited to only 20 km (12.4 miles).

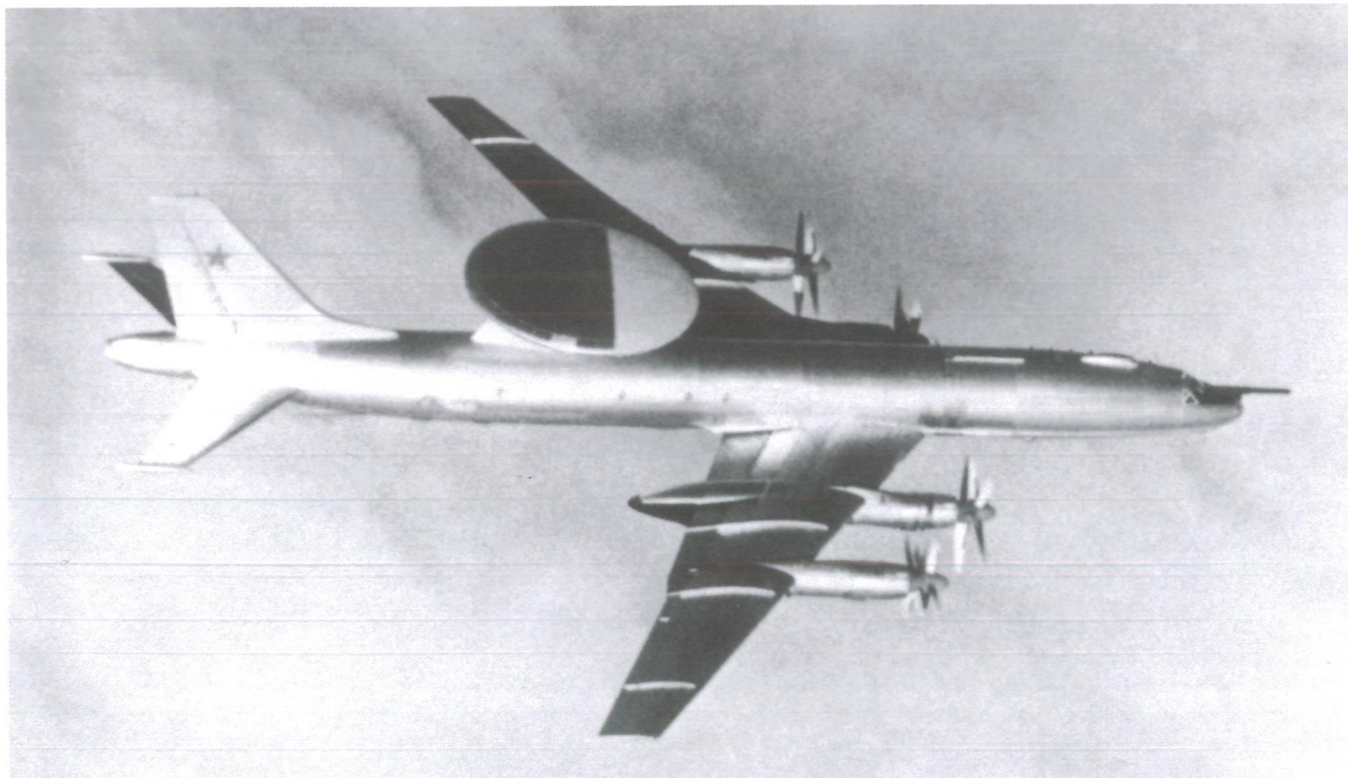
The new Tu-114 *Cleat* four-turboprop long-haul airliner proved a near-perfect candidate for an AEW&C platform; the mission avionics would fit into the Tu-114's fuselage of 4.2 m (13 ft 9⁹⁄₃₂ in) diameter without difficulty. The AEW&C aircraft was designated '126' (Tu-126) or *izdeliye* (product) L, the code referring to the Liana suite.

The search radar's antenna was housed in a revolving lentil-shaped fairing, or rotodome, 11 m (36 ft 1 in) in diameter and 2 m (6 ft 6¾ in) deep mounted dorsally on a broad-chord pylon about halfway between the wings and the fin. Apart from the rotodome 'mushroom' and the ventral strake offsetting its destabilising influence, the airframe incorporated only minor changes from the Tu-114, such as the deletion of most of the cabin windows and the addition of fairings over navigation, communications and ECM equipment. Among other things, cigar-shaped fairings mounted at the tips of the horizontal tail housed the antennas of the ***Lee**ra* (Lyre) data link system.

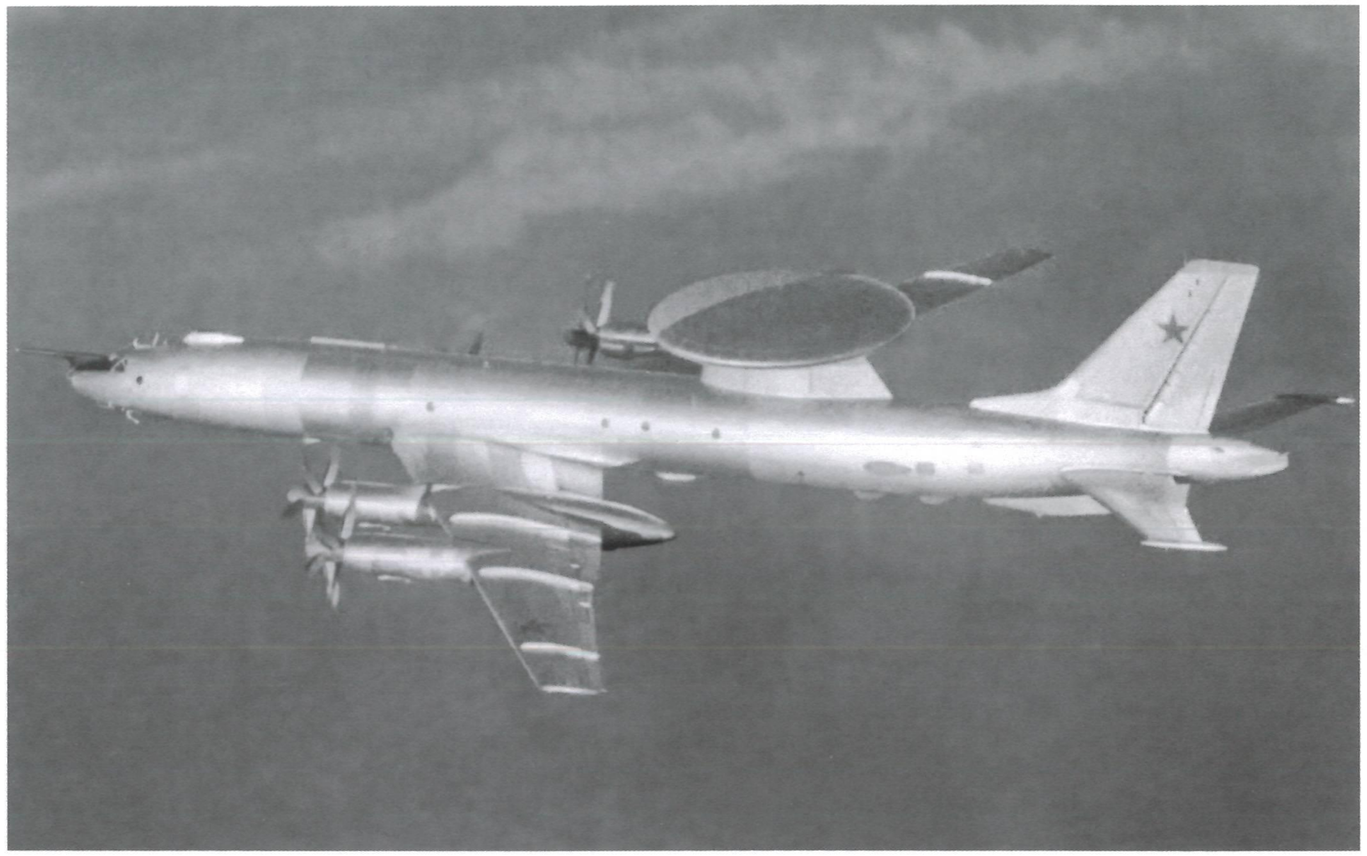
The forward and centre fuselage accommodated the mission crew's workstations and



A Tu-126 on the 67th Independent AEW Squadron's hardstand at Šiauliai.

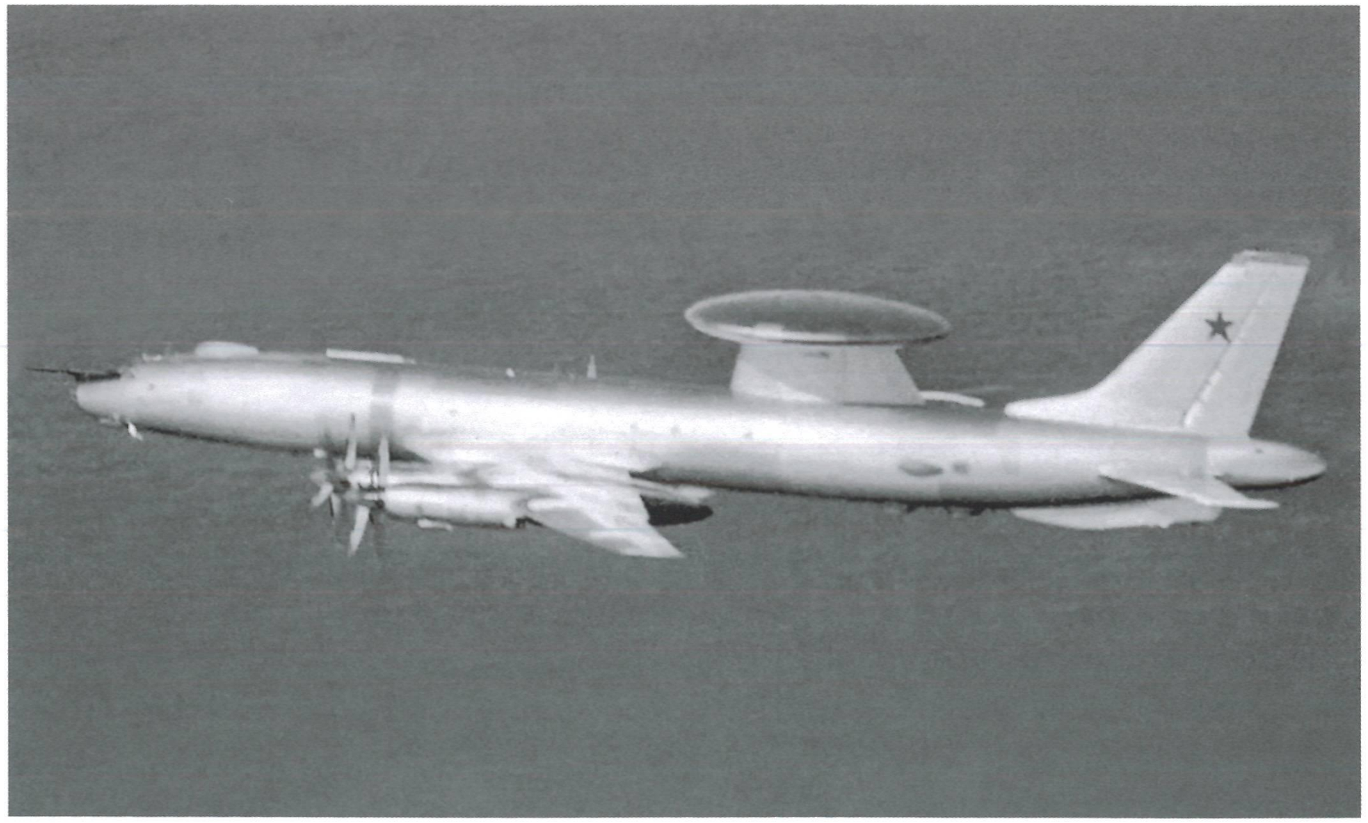


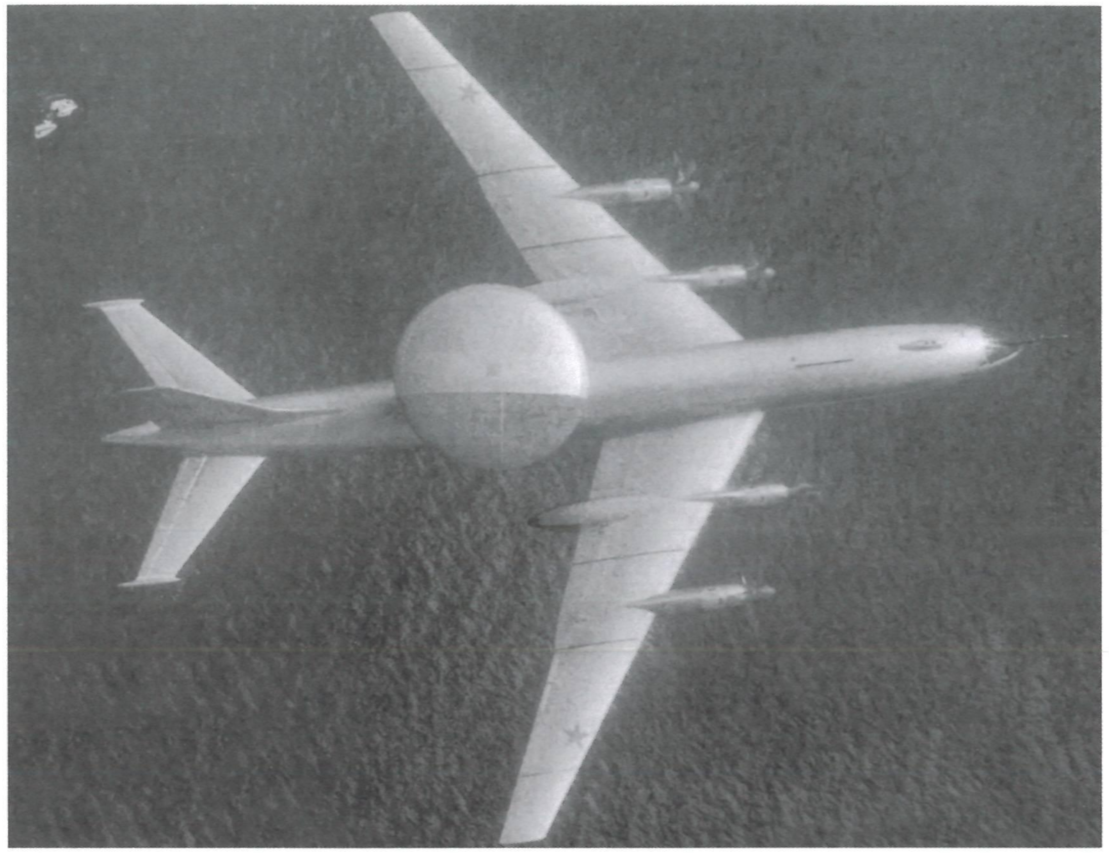
This view shows the Tu-126's rotodome (the light-coloured section is dielectric) and the rear ECM fairing.



Two views of a Tu-126 cruising over the sea.

a rest area for the relief crew. The Tu-126 had a crew of 12 – captain, co-pilot, two navigators, a radio operator, a flight engineer and a six-man mission crew (an intercept control officer, three radar display station operators, an ECM/ESM officer and a maintenance engineer to repair any faulty equipment in flight). Two full crews would be carried, working in shifts.





One more view of the Tu-126 over water accentuating its large, high aspect ratio wings.

The rear half of the fuselage housed the radar set and communications equipment. Since the radar and other equipment generated harmful high-frequency radiation, radiation shielding was used to protect the crew.

The designers chose to dispense with the defensive armament envisaged originally, opting for a powerful electronic countermeasures (ECM) system for protection against fighter attack. Additionally, the aircraft was equipped with a probe-and-drogue in-flight refuelling (IFR) system for working with Myasishchev 3MS-2 *Bison-B* tankers, which would permit it to stay on station for virtually unlimited periods of time.

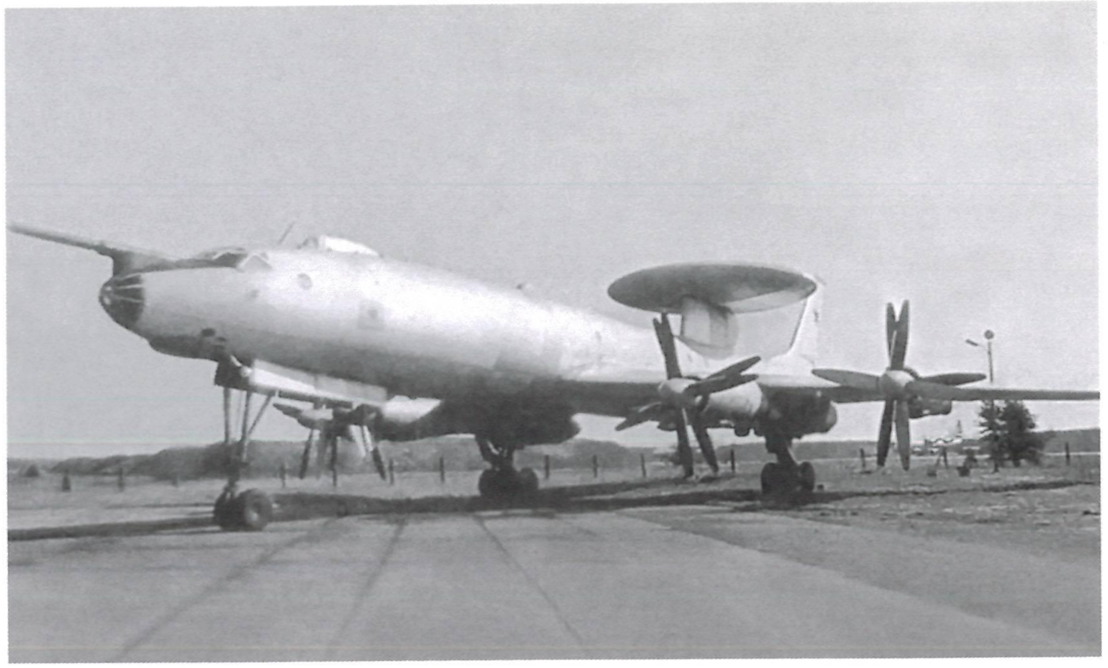
The prototype was completed by the Kuibyshev aircraft factory No.18 (which built the Tu-114) at the end of 1961. On 23rd February 1962 (incidentally, a major public holiday – Soviet Army Day) the Tu-126 took to the air for the first time from the factory's Bezymyanka airfield with Tupolev OKB chief test pilot Ivan M. Sookhomlin as captain.

The tests were not altogether trouble-free. The huge rotodome and the rearward shift of the CG changed the aircraft's handling considerably as compared to the Tu-114. Furthermore, electromagnetic compatibility (EMC) of the mission avionics was poor and the avionics were notoriously unreliable.

Stage A of the Tu-126's state acceptance trials was completed on 8th February 1964; it was concerned with refining the Liana suite. Stage B, which was completed in November 1964, included testing the Liana system's compatibility with ground or shipboard air defence systems and command, control and communications (C^3) centres. Of particular concern was the ability to transmit data in ECM environments and in combat conditions.

In August 1963 a decision was taken to move ahead with Tu-126 production. However, because several important tests had not yet been completed, the aircraft did not actually enter production until early 1965. Due to the highly specialised nature of the aircraft the production run was extremely limited – only eight production aircraft in Batches 1 and 2 (plus the prototype in Batch 0) were manufactured in 1965-67. In the course of production, improvements in ECM systems were introduced. Thus, six aircraft featured an extended ogival tailcone housing an SPS-100A *Rezeda* (Mignonette) active jammer to complement the existing chaff dispensers.

On 30th April 1965 the Tu-126 was formally included into the PVO inventory. The type equipped a single squadron – the 67th Independent AEW Squadron (OAE DRLO – *ot**del'**naya **a**viaeskad**ril'**ya **dahl'**nevo **rah**di-*



Another Tu-126 at Šiauliai. This view underscores the tall landing gear. The dorsal blister aft of the flight deck houses star trackers for celestial navigation.

*olokatsi***on***novo obnaru***zhe***niya*) based near Šiauliai (pronounced '***Sha****ooliay*'), Latvia. The squadron consisted of two detachments with four aircraft each.

When the aircraft became known to the Western world, the NATO allocated the reporting name *Moss* to the Tu-126. The Liana radar also had a codename, *Flat Jack*.

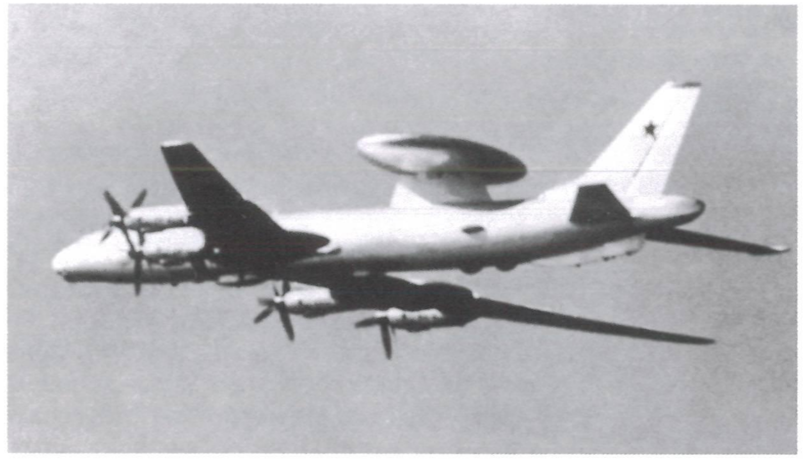
Normally the 67th Squadron operated in the interests of the 10th Independent PVO Army or the North Fleet. Up to four Tu-126s would be airborne at a time. The radar data were transmitted via secure data link to the data reception/processing centres at Vas'kovo (near Arkhangel'sk) and Severomorsk (near Murmansk), then forwarded to Moscow and

Here a Tu-126 is escorted by a McDonnell F-4J Phantom II. Note the reinforcement of the fuselage skin in the inboard propellers' rotation plane.

disseminated via the Vozdukh-1 GCI system. As a rule, the routes lay via Leningrad and Arkhangel'sk to Novaya Zemlya Island, or via the Kola Peninsula to the Zemlya Frantsa-Iosifa archipelago. The aircraft took three hours to reach the designated area and then loitered there for up to 2 hours 20 minutes. Normally missions lasted 8.5 hours, occasionally increasing to nine hours. Each summer two aircraft would deploy to a forward operating location at Olen'ya AB near Olenegorsk (Murmansk Region) for a couple of months, which allowed them to operate beyond Novaya Zemlya, working together with Yak-28P interceptors based at Rogachovo AB on that island and with Tu-128s from Arkhangel'sk-Talagi airport.

Another route took the aircraft to the Baltic Sea where they loitered near Gotland Island. In this case the mission lasted just five hours –

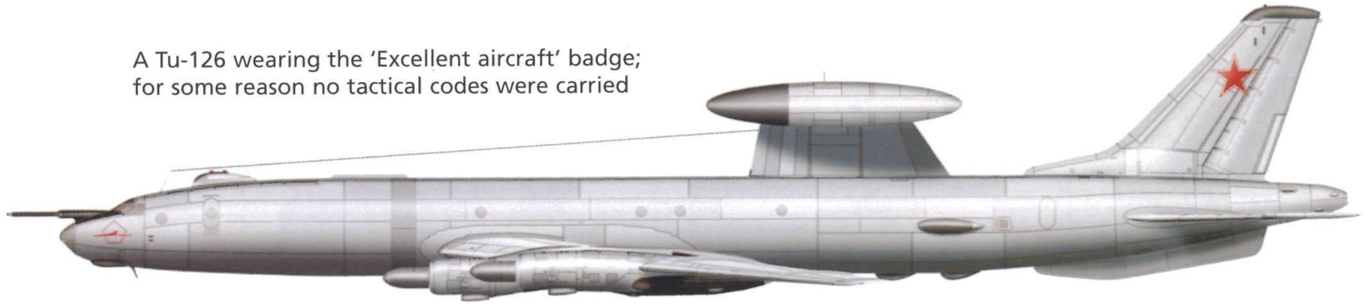
A still from a Soviet documentary showing a Tu-126 at the moment of getting airborne.



A Tu-126 as seen by the pilot of an escorting NATO fighter.

'Ye Olde & The New': 67th OAE DRLO personnel pose at Šiauliai with past (Tu-126) and present (A-50) generations of AWACS.

A Tu-126 wearing the 'Excellent aircraft' badge; for some reason no tactical codes were carried



the permitted airspace area was very confined, and there was no room for the Tu-126 to manoeuvre. There were cases when the Tu-126 inadvertently did intrude a few miles into Swedish or British airspace, causing fighters to scramble. Occasionally the *Moss* followed the western border of the Soviet Union as far south as the Black Sea. Also, the Tu-126s participated in major Soviet exercises, such as *Okean-70* (Ocean, pronounced *oki**ahn***).

Over international waters in the north the Tu-126s had encounters with NATO fighters and Lockheed P-3 Orion anti-submarine warfare aircraft, which occasionally came a bit too close for comfort. Knowing that the Orion's crew was eavesdropping on Soviet communications, the radar intercept officer occasionally got naughty and started playing radio games, simulating communications with Soviet interceptors and 'calling them in', whereupon the Orion would hastily depart. The Lockheed SR-71 was spotted occasionally by the Tu-126 crews, but only as a fast-moving blip on the radarscopes.

The advent of the Tu-126 gave the Air Defence Force significant advantages. The Liana system could identify four aerial or maritime targets at a time via IFF, track 14 targets at a time and determine their altitude. It was able to detect fighters at a distance of 100 km (62 miles) and bombers at a distance of 200-300 km (124-186 miles). At an altitude of 2,000-5,000 m (6,560-16,400 ft) it could detect fighters against background clutter at a distance of 100 km (62 miles) and large ships at 400 km (248 miles). Early warning could be provided at ranges of up to 2,000 km (1,242 miles) from PVO command centres; early warning times could be extended by up to three hours, depending on the distance to

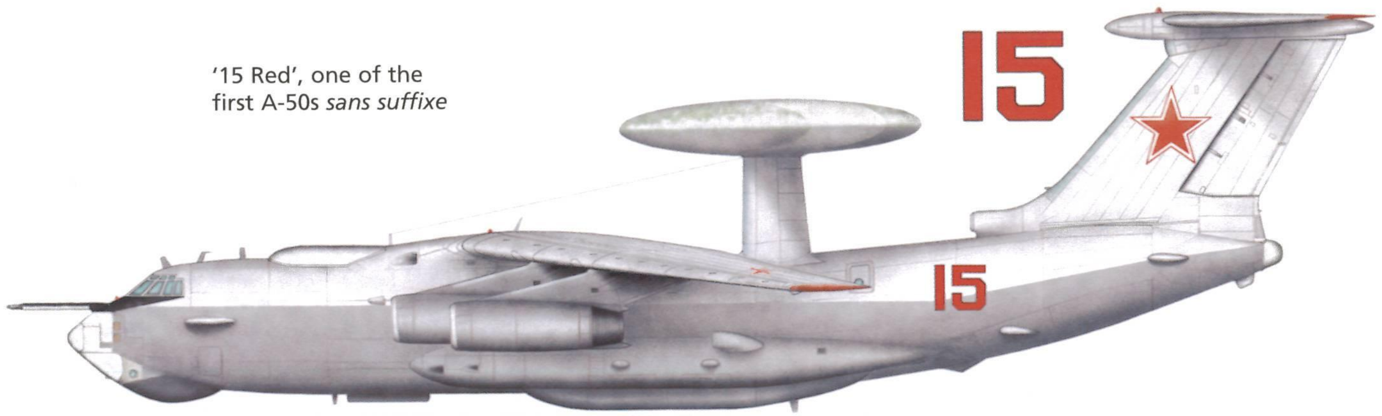
When seen from below, the Tu-126 was characterised by the exhaust stains on the main gear fairings and the wing underside. Note the variance in skin colours; all Tu-126s had a natural metal finish.

the patrol area. The high cruising speed of the Tu-126 allowed the PVO to change early warning options in response to possible attack scenarios; this was particularly important, considering the vast territory of the Soviet Union (for example, redeploying the aircraft from the Kola Peninsula in the north to Vladivostok in the Soviet Far East took ten hours). The Tu-126 could perform its mission in difficult conditions typical of the Arctic regions where land- and ocean-based pickets were often incapacitated by adverse weather.

The Tu-126 was found to be as effective against surface vessels as it was against airborne targets. The great range of its radar enabled it to operate at great distances from

A-50M '44 Red' in the type's standard grey/white finish.

A-50 *sans suffixe* '46 Red' is towed by a MAZ-537 prime mover.



'15 Red', one of the first A-50s *sans suffixe*

Opposite: A-50 '47 Red' takes off past two sister ships. Note the ECM blisters.

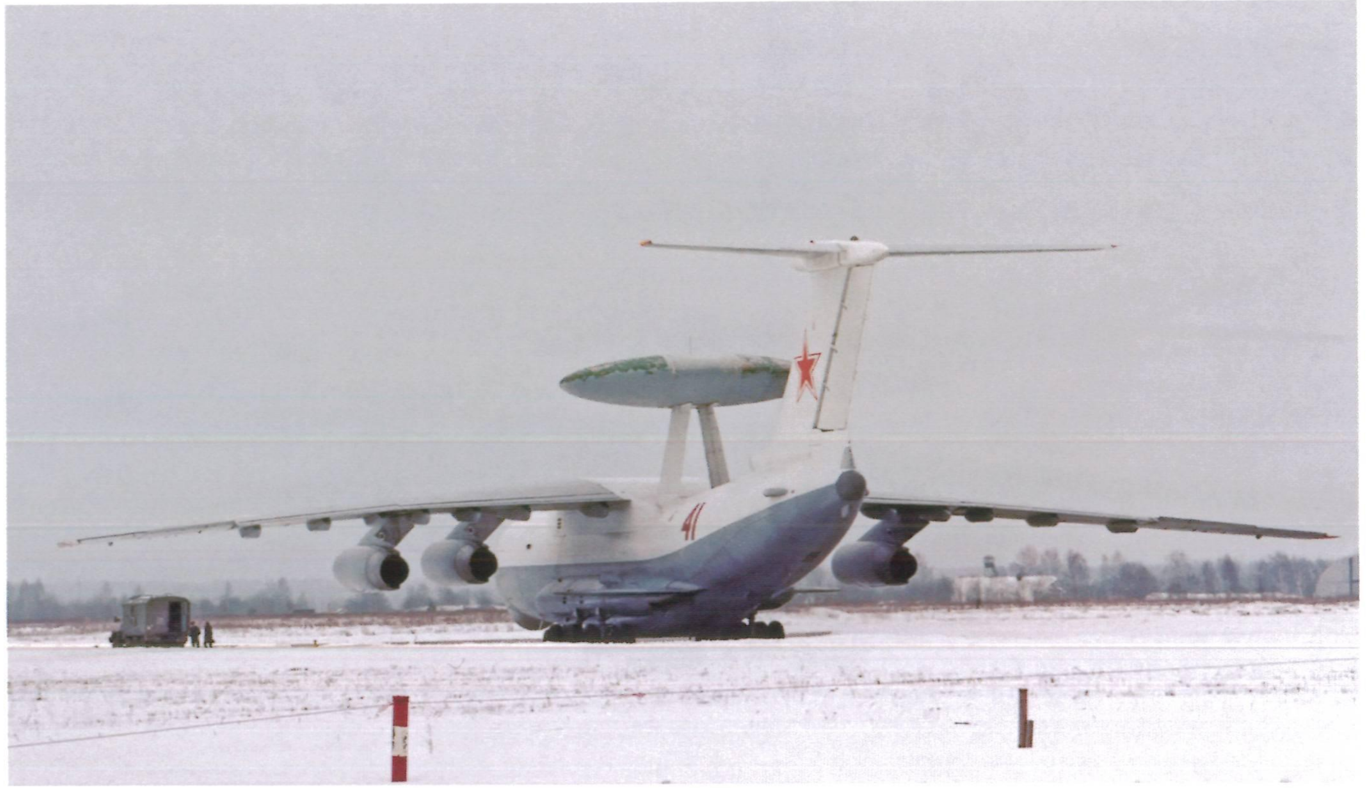
This photo shows how the inside of the rotodome can be accessed for maintenance via a hatch and a stepladder.

Here '47 Red' is pushed back onto its parking spot, with a TZ-22 fuel bowser waiting to refuel it for the next mission.

hostile carrier task forces while monitoring their activities. This stand-off range and the aircraft's high speed also reduced the risk of interception by carrier-borne fighters. The Tu-126 also had a secondary SIGINT role.

Conversely, co-operative intercepts utilising the Tupolev Tu-128 long-range interceptor in concert with the Tu-126 were investigated. Upon detailed study, the PVO came to the conclusion that such a system could extend enemy aircraft interception range to 1,000 km (621 miles) from the Soviet borders, neutralising the threat posed by Western bombers. To cater for the co-operative intercepts, an intercept officer was introduced into the Tu-126's crew. It thus became possible to integrate the Tu-128's capabilities with the long-range detection data from the Tu-126. This had not previously been considered an aspect of the Tu-126 mission; once this technique had been perfected, however, it worked well.

Unfortunately the Tu-126 remained viable as an early warning and control system only until the end of the 1960s. By then NATO strike aircraft had gained the ability to penetrate Soviet airspace at low and ultra-low altitudes. Detecting them at acceptable range was beyond the Tu-126's capabilities. One of the inherent shortcomings in the Liana radar was its very limited 'look-down' capability against low-flying targets. As a result, development of a new system was initiated, resulting in the Il'yushin/Beriyev A-50 (see below). Still, the handful of Tu-126s soldiered on until 1984 when sufficient numbers of the A-50 were available to replace them.



Rear view of A-50 *sans suffixe* '41 Red' showing the rear radome and ECM antennas and the faired-over cargo doors.

Il'yushin/Beriyev A-50 (*izdeliye* A, *Mainstay-A*) and A-50M (*izdeliye* 2A, *Mainstay-B*)

As early as 1969 the Council of Ministers initiated development of a successor to the Liana AEW&C system that would be capable of detecting and tracking low-flying targets, including cruise missiles, with the intention of fielding it in the early 1980s.

The Tupolev OKB proposed an all-new AEW&C aircraft designated Tu-156 that shared the layout of the Boeing E-3A Sentry. However, the Soviet military posed a key requirement that the future airborne warning and control system should be based on an existing aircraft. Therefore, the choice of the IL-76 *Candid* four-turbofan transport (first flown on 25th March 1971) as the second-generation AWACS platform came as no surprise. True, the stillborn Tu-156 would have offered higher flight performance. However, the IL-76 was able to operate from semi-prepared runways, which might be necessary in times of war. Besides, in 1973 it was already in production at aircraft factory No.84 in Tashkent and entering Soviet Air Force service; it had built up quite a good reliability record, which meant there would be fewer operational problems with its special-mission derivative. Thus, in 1973 the IL-76 was officially selected as the basis for the new AWACS.

Following the example of its competitor, the Il'yushin OKB teamed up with NIIP, which was responsible for the mission avionics. It also joined forces with the Beriyev OKB, which was to act as systems integrator for the new AWACS derivative of the IL-76M *Candid-B* military transport. The resulting aircraft was designated A-50 or *izdeliye* A; the 'non-Il'yushin' designation is due to the fact that the Beriyev OKB performed the integration effort.

The A-50 is equipped with the Shmel' (Bumblebee) mission avionics suite built around a coherent pulse-Doppler 360° surveillance radar of the same name. The radar can track up to 50 targets at a time with a maximum range of 230 km (142 miles); large targets like surface ships can be detected and tracked at up to 400 km (248 miles). The suite also includes an active IFF system, a data processing and presentation system, data storage equipment and secure digital communications/data link equipment for communicating with C^3 centres and friendly fighters.

The main structural change as compared to the IL-76M was the rotodome of 10.8 m (35 ft 5$\frac{3}{16}$ in) diameter and some 2 m (6 ft 6$\frac{3}{4}$ in) deep mounted on twin pylons immediately aft of the wings. The need to accommodate the mission equipment led to a few other airframe changes; among other things, the extensive glazing of the navigator's station was replaced by a large dielectric fairing. The glazing had gold plating to protect the crew from the electromagnetic pulses generated by the radar. The IL-76's port side entry door was deleted as superfluous, leaving one door to starboard; so was the cargo door. The tail gunner's station of the *Candid-B* gave way to an avionics bay, with a large cooling air intake added at the base of the fin. The main landing gear fairings were modified to house some of the equipment; this necessitated relocating the auxiliary power

The rotodome of '41 Red' shows a lot of wear and tear, with chipped and faded paintwork.

unit from the front portion of the port fairing to its rear end.

Like its predecessor, the A-50 had IFR capability, the telescopic refuelling probe being located ahead of the flight deck glazing. This allowed it to work with IL-78 *Midas* tankers based on the IL-76MD.

The fully pressurised cargo hold was converted into a mission crew cabin and an avionics bay. The A-50 had a crew of 15: captain, co-pilot, flight engineer, navigator, radio operator and ten mission equipment operators – radar intercept officers, ECM officers and communications officers.

Western intelligence got wind of the A-50's development in 1983 and the aircraft was allocated the unusually laudatory reporting name *Mainstay*. By then, three prototypes had been converted from *Candid-Bs* by the Beriyev OKB; the first prototype made its maiden flight at Taganrog-Yoozhnyy on 19th December 1978, captained by test pilot V. P. Dem'yanovskiy. The first aircraft served for performance and handling tests, the second machine served for verifying the Shmel' suite as such and the *Poon**teer*** (Dotted line) navigation suite, while the third one was used for ECM equipment trials. The main part of the trials took place in Akhtoobinsk near Saratov, southern Russia, in 1980-85. The State commission holding the trials was chaired by none other than Soviet Air Force C-in-C Air Chief Marshal Pavel S. Kutakhov, a fact testifying to the degree of importance attached to the A-50.

As the results of the trials were encouraging, in December 1984 it was decided to launch A-50 production at the Tashkent aircraft factory (by then renamed the Tashkent Aircraft Production Corporation). Production proceeded at a rate of one to five aircraft per year until 1991; the factory supplied 'green' A-50 airframes, which were flown to Taganrog for outfitting. Deliveries to the PVO commenced in 1985; the 67th OAE DRLO at Šiauliai progressively re-equipped with A-50s, allowing the Tu-126 to be retired, and the evaluation stage lasted until 1988. During this time the flights were confined to Soviet territory. The first encounter with a Western combat aircraft over international waters did not take place until 4th December 1987. In 1989 the A-50 was officially included into the inventory. Later, when the existence of new versions was revealed, the reporting name of the original A-50 *sans suffixe* was amended to *Mainstay-A*.

Until 1990 the A-50s flew primarily routine training missions, periodically participating in major Soviet or joint Warsaw Pact exercises. Soon the 67th Squadron had to leave Šiauliai for political reasons, moving north to Beryozovka AB near Pechora on the Kola

Opposite: An A-50 creates a small snowstorm as it uses reverse thrust on arrival at a wintry airbase.

Opposite, below: An A-50 flies over the foothills of the Caucasus during an exercise.

Rear view of A-50M '44 Red', showing the extra antennas and the chaff/flare dispensers for self-protection. The dark smudge is an APU exhaust stain.

A fine air-to-air study of pristine-looking A-50 *sans suffixe* '42 Red'.

Peninsula. A-50s were also detached to the Far East Military District and to the Crimea Peninsula, operating from Black Sea Fleet air-bases and checking on the Soviet Union's southern borders in practice missions.

In a typical mission the A-50 loiters at about 10,000 m (32,810 ft) on a figure-eight course with 100 km (62 miles) between the centres of the two orbits. The Shmel' surveil-lance radar can track up to 50 targets at a time over land and water and detect surface ships as well as aerial targets. The A-50 usually works in concert with Mikoyan MiG-31 inter-ceptors, and can guide up to ten fighters at a time. Target data are transmitted to the inter-ceptors automatically via data link or by secure voice link. Transmission range to ground com-mand, control, communications and intelli-

Below and opposite page: Three more views of the same aircraft flying above the clouds.

gence (C³I) centres is 350 km (217 miles) in the metre and decimetre wavebands and 2,000 km (1,242 miles) in the UHF range; satellite communication equipment is used over longer distances.

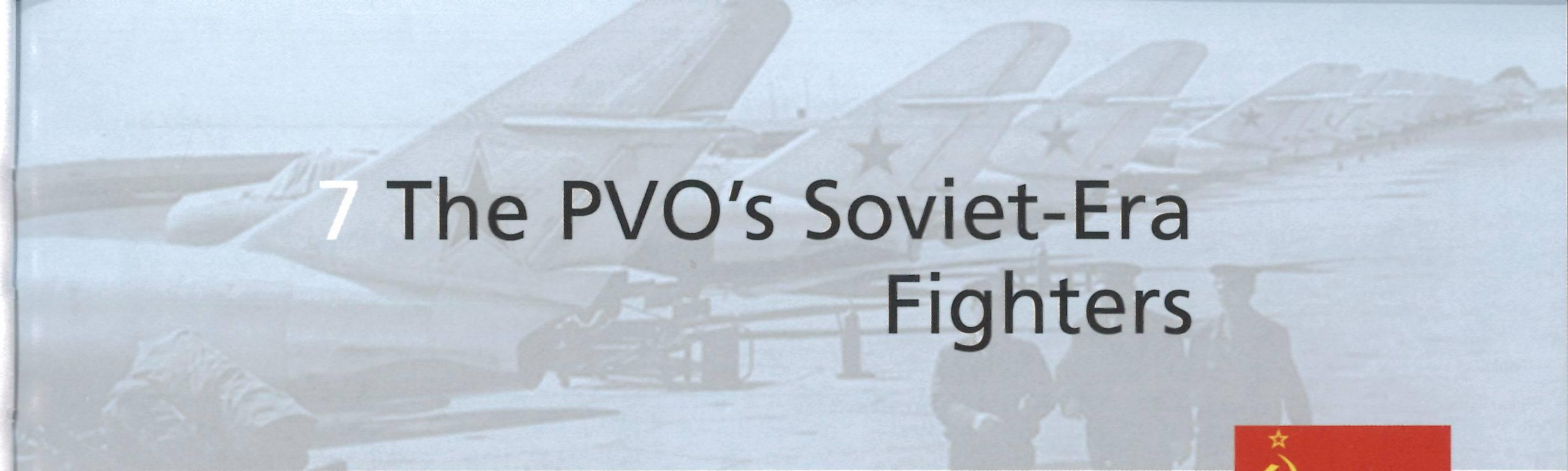
The A-50 has been involved in several armed conflicts. During Operation Desert Storm in 1990 two *Mainstays* took turns patrolling over the Black Sea, continuously monitoring the operations of Iraqi and Allied forces and keeping a watch for stray US cruise missiles which might be heading towards Soviet territory.

A modest upgrade was brought out in the late 1980s as the A-50M (*moderni**zee**rovannyy* – upgraded, or *izdeliye* 2A). The changes concerned mostly the mission avionics – the aircraft featured the Shmel'-M mission suite; also, protection against missile attack was bolstered by the addition of strap-on 96-round chaff/flare dispensers augmenting the built-in dispensers. About six A-50Ms were built; the NATO reporting name is *Mainstay-B*. Overall A-50 production for the PVO Aviation (discounting the prototypes) by 1989 totalled 25.

Soviet AEW&C aircraft specifications

	Tu-126	A-50
Powerplant	4 x Kuznetsov NK-12MV w. AV-60K propellers	4 x Solov'yov D-30KP-2
Engine take-off power/thrust	4 x 15,000 ehp	4 x 12,500 kgp (27,560 lbst)
Length overall (less IFR probe)	57.9 m (180 ft 11³³⁄₆₄ in) [1]	46.59 m (152 ft 10¼ in)
Wing span	51.4 m (168 ft 7⅝ in)	50.5 m (165 ft 8 in)
Height on ground	15.5 m (50 ft 10¹⁵⁄₆₄ in)	14.76 m (48 ft 5 in)
Wing area, m² (sq ft)	311.1 (3,348.4)	300.0 (3,229.2)
Empty weight, kg (lb)	105,000 (231,485)	n.a.
Take-off weight, kg (lb):		
normal	155,172 (342,090) [2]	n.a.
maximum	171,000 (376,990) [2]	190,000 (418,875) [3]
Maximum landing weight, kg (lb)	n.a.	165,000 (363,760)
Maximum fuel load, kg (lb)	72,980 (160,890)	90,000 (198,412) [4]
Maximum speed, km/h (mph)	850 (528)	810 (503)
Cruising speed, km/h (mph)	650-700 (404-435)	750 (466)
Loiter speed, km/h (mph)	n.a.	600 (372)
Service ceiling, m (ft)	10,700 (35,100)	10,200 (33,460)
Loiter altitude, m (ft)	8,000 (26,250)	9,000-10,000 (29,500-32,810)
Range, km (miles):		
on internal fuel	7,000 (4,347)	5,000 (3,105)
with one fuel top-up	10,000 (6,212) [5]	7,500 (4,660)
Endurance, hours:		
on internal fuel	10.2	n.a.
with one fuel top-up	18.5	n.a.
On-station loiter time on internal fuel, hours	n.a.	4 at 1,000 km (621 miles) 1.4 at 2,000 km (1,242 miles)
Coverage against fighter-type targets, km (miles)	420 (261)	230 (142)
Coverage against large ships, km (miles)		400 (248)
Take-off run, m (ft)	2,400 (7,870) [6]	n.a.
Landing run, m (ft)	1,200 (3,940)	n.a.

Notes:
1. With rear ECM fairing and IFR probe
2. The normal and maximum TOW of the Tu-126 have also been reported as 170,000 and 175,000 kg (374,785 and 385,810 lb) respectively
3. Also reported as 151,000 kg (332,900 lb)
4. Also reported as 64,820 kg (142,900 lb)
5. Maximum range and endurance have also been quoted as 12,550 km (7,798 miles) and 25 hours – probably with two fuel top-ups
6. With a 166,000-kg (365,960-lb) TOW



7 The PVO's Soviet-Era Fighters

In the post-war years the PVO Aviation operated a succession of fighters developed by the Lavochkin, Mikoyan, Sukhoi and Yakovlev bureaux. An overview of the principal types is given below.

Lavochkin La-9 fighter (*izdeliye* 48, *Fritz*)

In 1945, continuing its wartime line of radial-engined fighters, Semyon A. Lavochkin's OKB-301 began developing two fighters that bore the in-house designations '126' and '130'. Both fighters were structurally identical, except that the former type retained plywood wing skins while the '130' was of all-metal construction, which saved structural weight.

The first prototype of the '130' fighter was built in January 1946 at Plant No.21 in Gor'kiy (now Nizhniy Novgorod), the production plant which manufactured the La-7. In February the machine was moved to Khimki near Moscow, the seat of the Lavochkin OKB, and manufacturer's flight tests began; they were completed in May. On 9th June 1946 the aircraft was submitted to GK NII VVS (Red Banner State Research Institute of the Air Force) for state acceptance trials; these were completed on 10th October with good results. In the course of the trials GK NII VVS also undertook development work that allowed some of the machine's bugs to be rectified; among other things, the staff of the institute made improvements to the control system, reducing the stick forces to a normal level. Concurrently, at the suggestion of TsAGI aerodynamicist Gheorgiy P. Svishchev the airfoil of the wing centre section was given a more pointed leading edge, which improved the fighter's spinning behaviour considerably.

The '130' was powered by a Shvetsov ASh-82FN 14-cylinder radial with a two-speed supercharger driving a VISh-105V-4 three-blade variable-pitch propeller of 3.1 m (10 ft 2 in) diameter. The lighter all-metal construction of the airframe made it possible to increase the number of fuel tanks from three to five, enabling the machine to be used as an escort fighter; total fuel capacity was 825 litres (181.5 Imp gal). The armament comprised a quartet of synchronised 23-mm (.90 calibre) Nudelman/Suranov NS-23 cannons in the nose providing a 6-kg/sec (13.2-lb/sec) weight of fire, with a total ammunition supply of 300 rounds. Firing control was of the electro-pneumatic type, permitting the lower or upper pair of cannons to be fired separately, or all four weapons to be fired at once. The aircraft was fitted with an RSI transmitter and an RSI-6M receiver, an RPKO-10M direction finder (***rah**diopolu**kom**pas*) and an SCh-3M IFF transponder ([*ot**vet**chik*] ***svoy**-choo**zhoy***). A breathing apparatus with

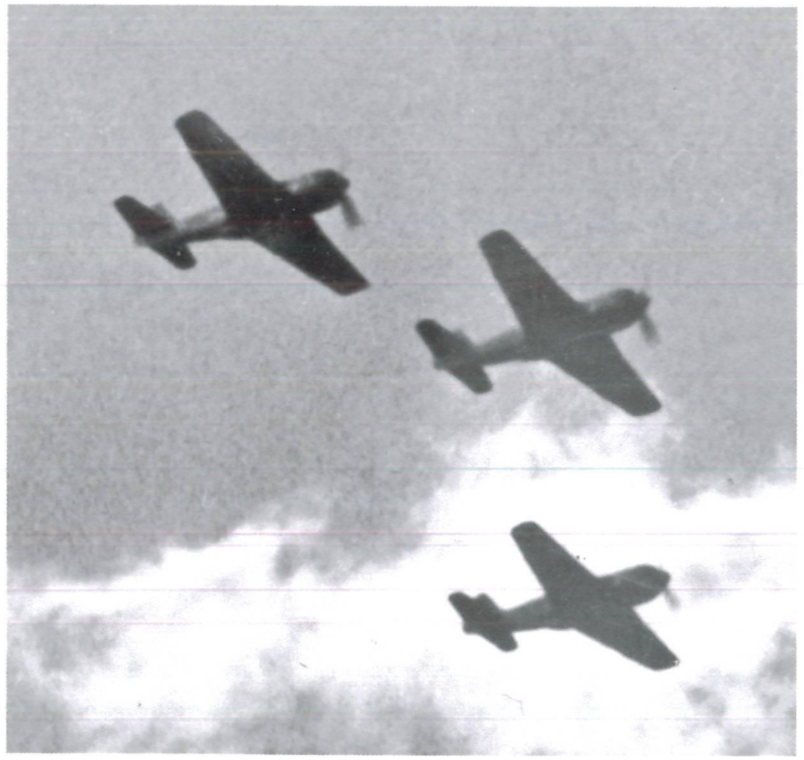
Operational La-9s in green camouflage with pale blue undersides.

a 4-litre (0.88 Imp gal) oxygen bottle was provided for high-altitude operations.

As regards range and endurance in economical cruise mode, the '130' was markedly superior to the production La-7, Yak-3 and Yak-9U fighters. This allowed it to be used for escorting short-range bombers within their full combat radius, providing the fuel capacity was further increased. The weight of fire was also considerably superior to the three abovementioned types.

Attempts were made to rectify many of the first prototype's shortcomings of the '130' on the second aircraft designated '130D' (*doob**lyor*** – lit. 'understudy', the then-current Soviet term for second prototype); it was also subjected to the full range of factory tests and state acceptance trials. In 1946 the aircraft entered series production at Plant No.21, receiving the official service designation La-9; its product code at the factory was *izdeliye* 48. The first four production machines were manufactured in August 1946, but it was not before 20th December that they were accepted by the customer. In 1947 the first 30 La-9s were sent for service trials to Tyoplyy Stan airfield in the southern suburbs of Moscow (the area is now part of the city and the airfield is long since gone).

The aircraft was subjected to constant improvements. Thus, on production La-9s the fuel capacity was increased to 850 litres (187 Imp gal). Also, the PBP (V) gunsight was replaced by an ASP-1N computing optical gunsight (*avtoma**tich**eskiy strel**kov**yy pri**tsel***); the latter was a copy of the British Mk 2D gunsight used on Lend-Lease fighters supplied to the Soviet Union during the war.



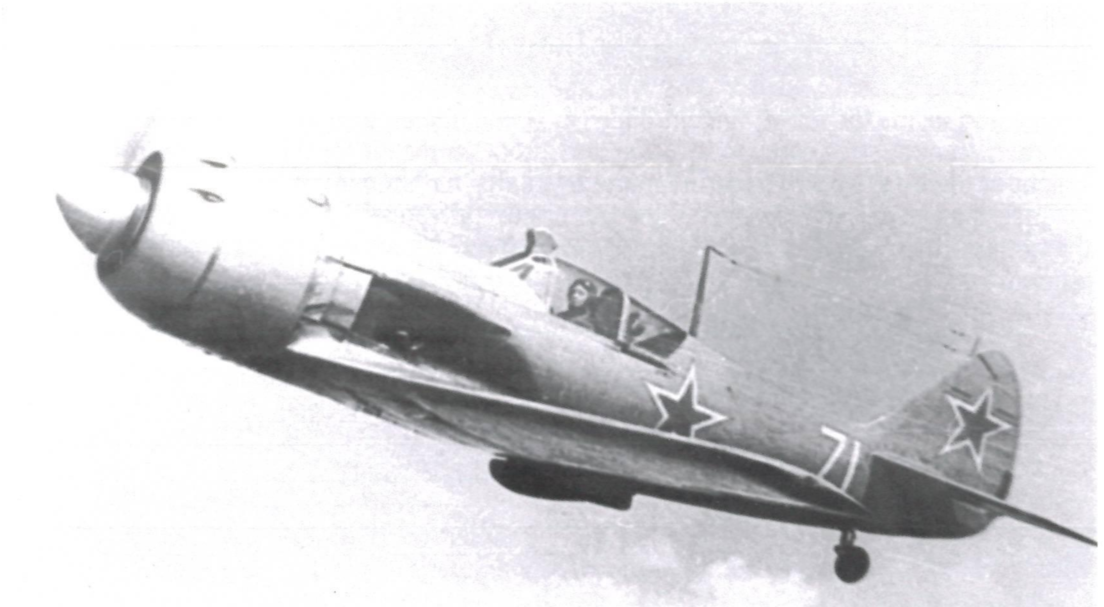
A flight of La-9s at an air event.

Check-up tests of production examples at GK NII VVS In May 1947 corroborated the performance figures previously obtained with the prototype, with the exception of range. At an all-up weight of 3,675 kg (8,104 lb), technical range in optimum cruise (altitude 1,000 m/ 3,280 ft, indicated airspeed 381 km/h; 237 mph) equalled 1,995 km (1,240 miles), endurance being 5 hours 09 minutes versus 1,735 km (1,078 miles) and 4.5 hours for the '130' prototype. High-speed range at 430 km/h (267 mph) IAS and an altitude of 6,000 m (19,680 ft) was 1,060 km (659 miles), endurance being 3 hours 21 minutes.

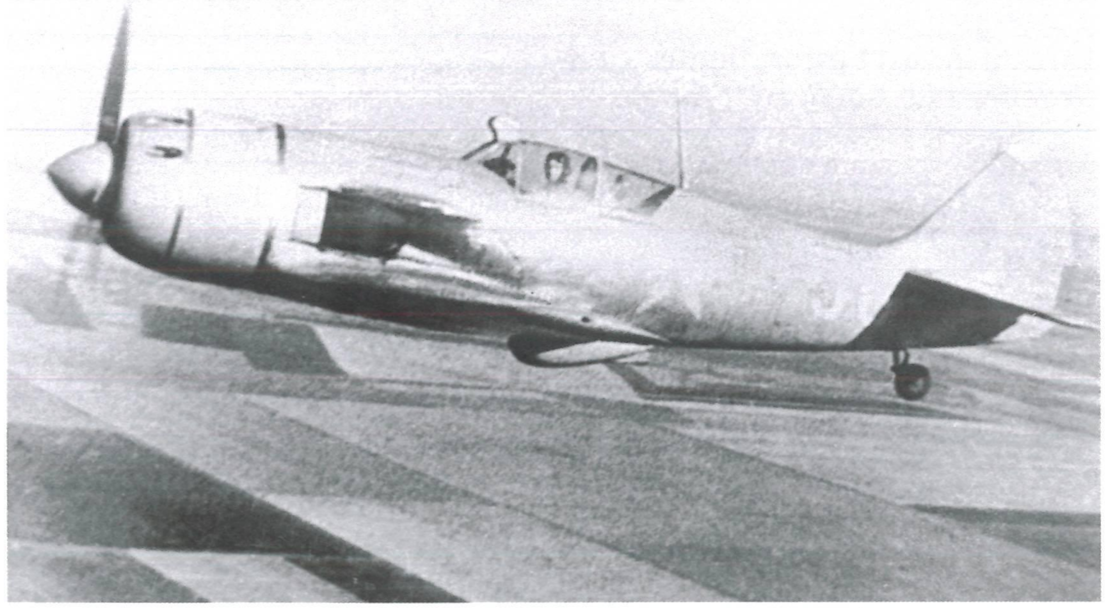
From 1947 onwards Plant No.99 in Ulan-Ude also started manufacturing the La-9. Testing of the first Ulan-Ude built machine commenced on 9th July. In the course of series production a total of 1,559 La-9 aircraft was built. Of these, 15 were produced in 1946, 840 in 1947 and 704 in 1948.

Lavochkin UTI La-9 fighter trainer (*izdeliye* 49)

The trainer version of the '130' was designed in accordance with a Council of Ministers directive dated 18th October 1946. The



Many La-9s sported an overall grey finish, like '71 White' pictured here.



Even though the La-9 was considered an escort fighter, it was used by the IA PVO as much as by the Air Force.

The UTI La-9 trainer had tandem cockpits and an oil cooler relocated to a chin position.

trainee and instructor sat in tandem under a common canopy. To compensate for the weight of the extra crew member the number of fuel tanks was reduced to three and the armament was limited to a single NS-23 cannon.

The aircraft passed manufacturer's flight tests in May 1947; state acceptance trials began on 2nd July. In April 1948 the trainer entered production at Plant No.99 in Ulan-Ude as the UTI La-9 (*oo**cheb**no-treni**rov**ochnyy istre**bit**el'* – fighter trainer); the factory product code was *izdeliye* 49. Two versions were produced; one had an NS-23 cannon while the other was armed with a synchronised 12.7-mm (.50 calibre) Berezin UBS machine-gun. This apparent downgrade was caused by the wish to lessen the risk of hitting not only the towed target but also the target tug during aerial gunnery practice.

Lavochkin La-11 escort fighter (*izdeliye* 140, *izdeliye* 51; *Fang*)

The concluding part of the '130' fighter prototype's state acceptance trials report said that *'...for the purpose of further enhancing the aircraft's performance, as well as for widening the scope of missions performed by the aircraft, it is necessary to modify the aircraft with a view to producing an escort fighter capable of escorting bombers, with a range of no less than 2,500 km [1,550 miles] at a speed equal to the bombers' cruising speed'*. Hence the abovementioned Council of Ministers directive No.2339-996 also stipulated the creation of an escort fighter based on the '130' aircraft.

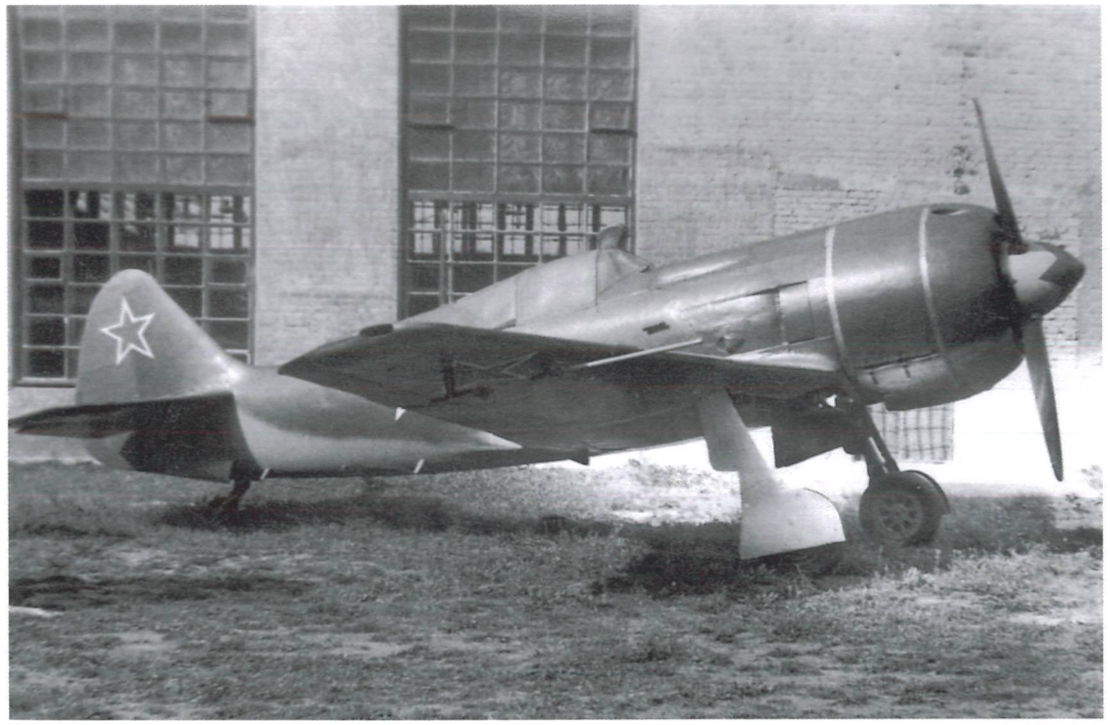
It took OKB-301 just six months to create what was initially known as the '134' or La-9M (*modifi**tsee**rovannyy* – modified). The fighter took to the air for the first time in May 1947 at the hands of test pilot Andrey G. Kochetkov. On 19th June the first prototype was turned over to GK NII VVS for state acceptance trials. Five days later it was joined by the second prototype, the '134D', which differed in having longer range thanks to an internal fuel capacity increased from 825 to 1,100 litres (from 181.5 to 242 Imp gal) and provisions for non-jettisonable tip tanks holding a total of 332 litres (73 Imp gal).

The aircraft was armed with three NS-23 cannons versus four on the La-9, and the total ammunition supply was reduced to 225 rounds. The oil cooler was moved from its position amidships to a chin position, and the capacity of the oil system was increased. The gross weight of the '134' increased by 571 kg (1,260 lb) as compared to the '130', necessitating a reinforced undercarriage. The increased endurance when escorting bombers (more than seven hours) called for the installation of an additional oxygen bottle and a urinal for the pilot; the seat was fitted with padded adjustable armrests and a broad padded backrest. The aircraft was fitted with an APSN-44 automatic supercharger speed governor (*avto**maht** pereklyu**chen**iya sko**rostey** nagne**tah**telya*) and an automatic device for regulating the cylinder head temperature. The equipment included an AFA-IM aerial camera for vertical photography.

In the course of the state acceptance trials, which were completed on 24th July, the '134' and '134D' performed 71 flights between them, with a total duration of 59 hours 13 minutes. On 10th July military test pilots Ivan M. Dziuba and Vasiliy I. Alekseyenko per-

The La-11 was the ultimate evolution of the Lavochkin piston-engined fighter family and was used by the Air Force and the PVO alike. Note the oil cooler position.

'41 White', a grey-painted La-11 sporting an appropriate badge on the cowling. Contrary to the then-current standard, there is no star insignia on the tail.



Some La-11s wore this green camouflage scheme with pale blue undersides. Note the red star on the propeller spinner.

formed two long-distance flights to determine the range, one of these lasting 4 hours 54 minutes and the other one lasting 2 hours 47 minutes. Technical range was determined on the assumption that two dogfights, each lasting 10-16 minutes, would take place during the sortie.

Despite the efforts of the designers (including measures to cut drag), the retention of the identically rated powerplant made it impossible to meet the performance target stipulated by the Council of Ministers directive. Suffice it to say that maximum speed at sea level proved to be 25 km/h (15.5 mph) less than specified; at 6,200 m (20,340 ft) it was 6 km/h (3.7 mph) less than specified.

With a full fuel load the '134' differed markedly from the production La-9 as regards aerobatics techniques and handling. The test pilots also pointed out that its horizontal and vertical manoeuvrability (and hence dogfight potential) at altitudes above 7,000 m (29,970 ft) would be insufficient because the aircraft was underpowered. Nevertheless, so great was the need for an escort fighter to protect the Soviet heavy bombers (in the USSR such a bomber appeared in the shape of the Tupolev Tu-4) that the state acceptance trials report cleared the aircraft for service. In accordance with Council of Ministers directive No.2942-958 dated 22nd August 1947 the new escort fighter was ordered into production at Plant No.21 as the La-11. At Plant No.21 in Gor'kiy the fighter bore the product code '*izdeliye* 51', and production continued until 1951. (Here it should be noted that the production version of the '134' was known at OKB-301 as the '140'; this means it was sufficiently different from the prototypes to warrant a new in-house designation.) In 1947 the plant turned out 100 machines, followed by 650 in 1948. La-11 production was halted that year but reinstated in the following year and the plant manufactured an additional 150 machines in 1949. 150 La-11s were built in 1950 and the final 182 in 1951; total production amounted to 1,182 copies and was eventually terminated because jet fighters had come on the scene.

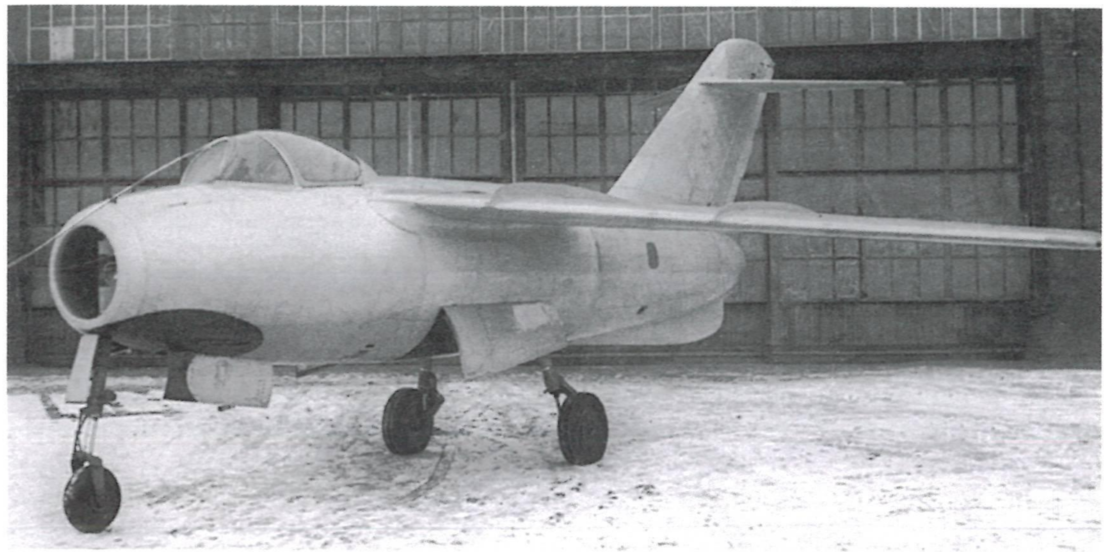
Lavochkin La-15 tactical fighter (La-174, *izdeliye* 52; *Fantail*)

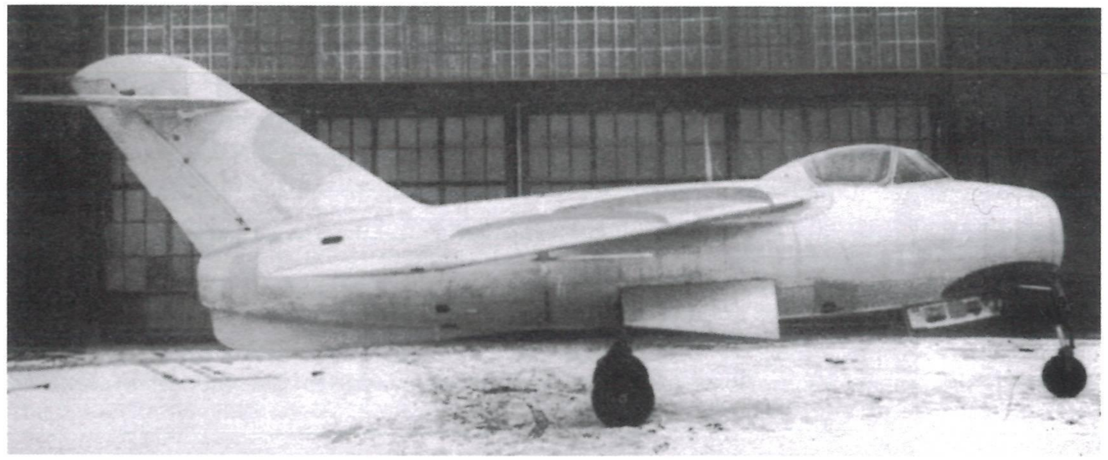
In December 1946 the Lavochkin OKB began development of the 'aircraft 168' swept-wing jet fighter representing a departure from the pod-and-boom layout characteristic of earlier Lavochkin jets. The aircraft had shoulder-mounted anhedral wings swept back 37°20' at quarter-chord and swept cruciform tail surfaces (actually, more like a T-tail). The aircraft was built around a 2,270-kgp (5,000-lbst) Rolls-Royce Nene II centrifugal-flow turbojet (built in the Soviet Union as the RD-45F) and was designed for high transonic speeds. The armament comprised a 37-mm (1.45 cal.) Nudelman N-37 cannon and two 23-mm (.90 cal.) Nudelman/ Rikhter NR-23 cannons.

The '168' prototype entered flight test on 22nd April 1948 and flew well. However, the competing MiG-15 was powered by the same RD-45 engine; both programmes were facing delays because production of the RD-45 was only just beginning. Here's where politics came in; Chief Designer Artyom I. Mikoyan's brother Anastas I. Mikoyan was a key figure in the Soviet government at the time, which meant the Mikoyan OKB could count on priority deliveries of Nene II engines. Lavochkin did not have such 'pull', and obtaining the Nene became a problem. Hence, as an insurance policy, he decided to design a scaled-down version of the '168' powered by the smaller 1,590-lbst (3,500-lbst) Rolls-Royce Derwent V turbojet – which, too, was copied and produced locally as the RD-500 – but having the same design performance.

The scaled-down version received the in-house designation 'aircraft 174'. To save time and effort, structural components and equipment items from the '168' were used insofar as possible. The armament consisted of three NR-23 cannons with 100 rpg; these were aimed by means of an ASP-1N computing gunsight. The design stage was completed in December 1947, and the '174' first flew on 8th January 1948. The revised second prototype ('174D') made its first flight on 12th June 1948; After making a mere seven flights under the manufacturer's flight test programme, which was then declared completed, the '174D' was submitted for state acceptance trials on 22nd June 1948.

The MiG-15 and the '174D' underwent state acceptance trials at the same time; in effect, this was a fly-off. The two fighters had broadly comparable performance – and very high performance by the day's standards. The MiG-15 had a top speed of 1,042 km/h (647 mph) while the '174D' attained a speed of 1,040 km/h (646 mph). Thanks to its higher thrust/weight ratio the MiG-15 had a better rate of climb, attaining 5,000 m (16,400 ft) in





The La-15 was built in small numbers and, again, was used by the IA PVO as well as by the Air Force. These photos show a brand-new example with no markings applied yet; note the black patch disguising the powder stains from the cannons.

La-15s on the final assembly line in Gor'kiy.

'457 Red', a Gor'kiy-built La-15 (note the 'Ла-15' badge on the nose). This view illustrates the type's narrow wheel track. Note also the pre-1955 insignia with stars both on the fuselage and the fin.

2.3 minutes versus three minutes flat for the Lavochkin fighter. On the other hand, the latter showed better turning, acceleration and deceleration characteristics. Thanks to its cleanly designed airframe the '174D' also exhibited better stability and handling, especially at high speeds.

The state acceptance trials were completed on 25th September 1948. A while earlier, on 23rd August, the Council of Ministers had issued directive No.3210-1303 ordering both fighters into production. The Lavochkin fighter (which initially bore the service designation La-174 but was redesignated La-15 in April 1949) was to be manufactured by two plants – No.21 in Gor'kiy, where it received the product code *izdeliye* 52, and No.292 in Saratov, southern Russia; full-scale production was to commence in January 1949.

This La-15 lacking the 'La-15' nose badge was probably Saratov-built.

The La-15 had shoulder-mounted wings and fuselage-mounted main gear units, unlike the mid-wing MiG-15 with which it was occasionally confused.

On 19th May 1949 the La-15 achieved initial operational capability with the 196th IAP at Kubinka AB which had previously operated the Yak-15. The new fighter was fast and agile, possessing an excellent rate of climb; it was also well armed and easy to maintain. Yet, that same month the La-15's fortunes suffered a dramatic downturn. The VK-1 turbojet, an uprated Soviet version of the RD-45F, successfully passed its state acceptance trials; this opened the possibilities for further enhancing the performance of combat aircraft, and the RD-500 immediately lost its appeal. Hence the Council of Ministers required combat jet production to be reorganised; apart from a specialised interceptor for the IA PVO, only one jet fighter and only one jet tactical bomber were to remain in production – both of them powered by VK-1 engines. It was decided to terminate La-15 production in Gor'kiy and switch Plant

Side view of the same La-15 showing the airbrakes and the fuselage break point. Note the post-1955 insignia and tactical code unrelated to the c/n.

Basic specifications of the La-15	
Powerplant	1 x RD-500
Thrust, kgp (lbst)	1,590 (3,500)
Length overall	9.563 m (31 ft 4½ in)
Fuselage length	8.235 m (27 ft 0 in)
Height on ground	3.8 m (12 ft 5³⁹⁄₆₄ in)
Wing span	8.83 m (28 ft 11⅝ in)
Wing area, m² (sq ft)	16.167 (173.83)
Normal take-off weight, kg (lb)	3,850 (8,490)
Empty weight, kg (lb)	2,950 (6,500)
Fuel capacity, litres (Imp gal)	1,060 (233.2)
Maximum speed, km/h (mph):	
at sea level	900 (559)
at high altitude	1,026 (637)
Effective range, km (miles)	1,170 (726)
Rate of climb, m/sec (ft/min)	31.7 (6,240)
Service ceiling, m (ft)	13,500 (44,290)
Armament	3 x NR-23 cannons (23-mm)
	100 rpg

No.21 to MiG-15 production. Also, the La-15 was plagued by manufacturing defects which caused a number of accidents and incidents. The fatal crash of the 196th IAP's CO, Guards Col. A. P. Shishkin, on 21st July 1949 sealed the fighter's fate. In August 1949 the Powers That Be took the decision to terminate La-15 production in Saratov as well; the fighter's total production run was a mere 235 aircraft.

As early as 1953 the Air Force started withdrawing the La-15, and the last examples were struck off charge in 1954. The La-15's NATO reporting name was *Fantail*.

Mikoyan MiG-15*bis* tactical fighter (*izdeliye* SD; *izdeliye* 53, *izdeliye* 55; *Fagot-B*)

First flown on 30th December 1947, the MiG-15 was the first swept-wing jet fighter developed by Artyom I. Mikoyan's OKB-155. The first production version, known in-house as *izdeliye* SV (and known to the West as the *Fagot-A*), entered flight test one year later and attained IOC with the Soviet Air Force in 1949. It was powered by a 2,270-kgp (5,000-lbst) RD-45F turbojet and had airbrakes of almost triangular shape with an area of 0.48 m² (5.16 sq ft) each. However, the *Fagot-A* saw fairly limited production in 1949-50 because the engine design bureau led by Vladimir Ya. Klimov had brought out an improved version of the RD-45F – the 2,700-kgp (5,950-lbst) VK-1, allowing the Mikoyan OKB to improve the MiG-15's performance considerably.

Bearing the in-house designation '*izdeliye* SD' (the D probably stands for *dora**bot**annoye* – revised), the new version of the MiG-15 incorporated the results of a year's production and operational experience with the type. The VK-1 had slightly larger dimensions and an extension jetpipe of larger diameter, necessitating changes to the internal structure of the detachable rear fuselage and a 60-litre (13.2 Imp gal) reduction in the capacity of the rear fuel tank. The airbrakes were enlarged to 0.5 m² (5.37 sq ft) each and reshaped to alleviate the MiG-15's annoying tendency to pitch up when the airbrakes were deployed, compli-

Gor'kiy-built MiG-15*bis* '410 Red' with 400-litre (88 Imp gal) drop tanks.

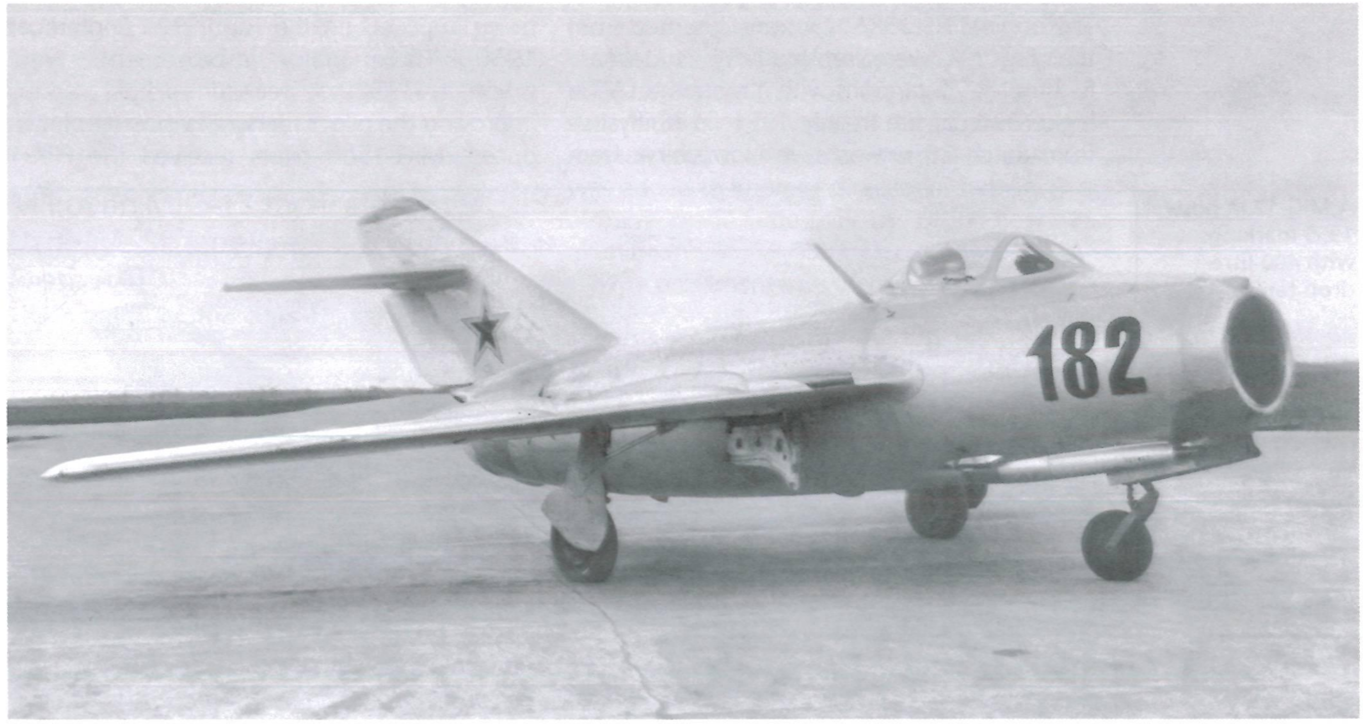
Blue-coded MiG-17s *sans suffixe* on the flight line.

cating gun aiming. A BU-1 reversible hydraulic actuator was added in the aileron control circuit, and elevator area was enlarged.

The *izdeliye* SD entered manufacturer's flight tests on 22nd July 1949. These were successfully completed on 9th September; four days later the prototype was submitted for state acceptance trials. The trials showed an overall improvement in performance over the basic *Fagot*, with the exception of range, which was 180 km (111 miles) shorter because of less internal fuel and a thirstier engine. The VK-1-powered version was faster, maximum speed at sea level being 1,076 km/h versus 1,050 km/h (668 mph versus 652 mph). Rate of climb at sea level increased from 42 to 46 m/sec (from 8,400 to 9,200 ft/min) and service ceiling improved from 15,200 to 15,500 m (from 49,870 to 50,850 ft). Take-off run was reduced by about 100 m (330 ft), being 504 m (1,653 ft). Conversely, landing roll increased by 70 m (230 ft), equalling 880 m (2,890 ft).

On the whole, the results were deemed satisfactory and the fighter entered production at six factories (No.1 in Kuibyshev, No.153 in

An early Kuibyshev-built MiG-15*bis* serialled '182 Blue'.



MiG-17s *sans suffixe* on the flight line; some aircraft are partly under wraps.

Novosibirsk, No.21 in Gor'kiy, No.31 in Tbilisi, No.126 in Komsomol'sk-on-Amur and No.292 in Saratov) in 1950. Most manufacturers referred to it as *izdeliye* 53, except the Kuibyshev plant which called it, somewhat confusingly, *izdeliye* 55. The new model was originally known simply as the 'VK-1-powered MiG-15' but became the MiG-15*bis* from 1951 onwards; the NATO reporting name was *Fagot-B*. This was the version that saw service with the IA PVO.

To make up for the shorter range the slipper tanks of the original MiG-15 (normally 250- or 300-litre/55- or 66-Imp gal units) were replaced by 400-litre (88 Imp gal) drop tanks. The original NS-23KM cannons inherited from the *Fagot-A* were replaced by Nudelman/Rikhter NR-23 cannons with a more than 50% higher rate of fire in July 1951 (in Kuibyshev from Batch 28 onwards, in Novosibirsk from Batch 15 onwards, in Gor'kiy and Saratov from Batch 10 onwards and in Komsomol'sk-on-Amur from Batch 29 onwards; Tbilisi-built *Fagot-Bs* had the new cannons from the outset). A new ASP-3N gunsight replaced the ASP-1N, paralleling armament development on the *izdeliye* SV. The MiG-15*bis* was a considerable improvement over the *Fagot-A* as a weapons system.

Over the years the MiG-15*bis* was steadily improved. The Mikoyan OKB and GK NII VVS undertook a special programme to cure the fighter's tendency to drop a wing at high speeds (which became even more acute on the faster MiG-15*bis* and led to a speed limit being imposed on the *Fagot-B* in September 1950). Three major improvements were made in 1952. A revised cockpit canopy improving the pilot's rearward vision was introduced. MiG-15*bis* pilots received the PPK-1

A MiG-17 in post-1955 markings with 400-litre drop tanks.

A MiG-17F shares the hardstand with a MiG-21

G-suit (***pro**tivopere**groo**zochnyy **kostyum***) using engine bleed air; it operated with loads of 1.75-8 Gs, making it easier to fly in a combat environment. Finally, the airbrakes were redesigned to improve manoeuvrability; their area was increased to 0.8 m^2 (8.6 sq ft) with no change to the aft fuselage structure (by simply incorporating new, larger skin panels) and the hydraulic actuators were beefed up.

The brand-new Sirena radar warning receiver (RWR) came next; it passed service trials in October 1952 on several MiGs fighting in Korea, with excellent results, and soon became standard equipment for the type. In November 1952 the standard ASP-3N gunsight was replaced by an improved ASP-3NM offering increased aiming accuracy and shorter aiming time in a dogfight.

Mikoyan MiG-17 tactical fighter (*izdeliye* SI; *izdeliye* 54, *izdeliye* 40; *Fresco-A*)

The success of the MiG-15 led OKB-155 to take an evolutionary approach, mating the fuselage, tail unit and VK-1 turbojet of the MiG-15*bis* with new wings swept back 45° at quarter-chord instead of 35° and a revised rear fuselage. This promised an improvement in performance at the expense of minimum changes in design and manufacturing technology. The new day fighter version received the manufacturer's designation *izdeliye* SI, the I probably standing for *izme**nyon**noye* (altered). Unsurprisingly, it was also known initially as the MiG-15*bis* 45°.

The wings had three boundary layer fences each instead of two, and the wing structure was stiffened by using thicker skins; Mikoyan had learned their lesson with the MiG-15 and its wing drop problem. The forward fuselage up to the fuselage break point was identical to that of the MiG-15*bis* but the rear fuselage was new, increasing overall length by 900 mm (2 ft 11$\frac{7}{16}$ in). Originally the airbrakes were only a little larger than on early *Fagot-Bs*, with an area of 0.522 m^2 (5.61 sq ft) each. They were to function primarily as dive brakes during bombing attacks. Vertical tail area was enlarged slightly from 4.0 to 4.26 m^2 (from 43.0 to 45.8 sq ft) but fin leading-edge sweep remained unchanged at 55°41'. The horizontal tail, however, was new, with 45° leading-edge sweep instead of 40° and an area of 3.1 m^2 (33.3 sq ft) versus 3.0 m^2 (32.25 sq ft). A small ventral fin with an integral tail bumper was added to improve directional stability. The airframe made large-scale use of the new V95 aluminium alloy.

The armament was identical to that of the MiG-15*bis*, comprising one N-37 cannon with 40 rounds and two NR-23s with 80 rpg. The avionics suite was likewise unchanged – an RSIU-3 Klyon (Maple) UHF communications radio, an SRO-1 ***Ba**riy-M* (Barium-M) IFF transponder (*samo**lyot**nyy **rah**diolokatsi**on**nyy ot**vet**chik* – aircraft-mounted radar responder), an RPKO-10M DF and an OSP-48 instrument landing system (*obo**roo**dovaniye sle**poy** po**sahd**ki* – blind landing equipment).

The SI-1 prototype made its first flight on 14th January 1950 with test pilot Ivan T. Ivashchenko at the controls. On 1st February

MiG-17F '51 Blue' sporting the 'Excellent [aircraft]' maintenance award legend.

the SI-1 reached 1,114 km/h (692 mph) at 2,200 m (7,220 ft); top speed at 10,200 m (33,460 ft) was 1,077 km/h (669 mph) or Mach 1.0. The aircraft outperformed the production MiG-15*bis* in almost every respect. Despite tailplane flutter problems which led to the loss of the first prototype, necessitating a redesign of the stabilisers, the manufacturer's test programme was completed in the spring of 1951. In April the aircraft was submitted for state acceptance trials, which were performed by Leonid M. Koovshinov, Yuriy A. Antipov, Vasiliy S. Kotlov and other NII VVS test pilots. The state acceptance trials were completed on 8th August. Generally the aircraft met the Air Force's requirements and was ordered into production as the MiG-17 by a Council of Ministers directive dated 25th August 1951 and a Ministry of Aircraft Industry (MAP – *Mini**ster**stvo aviatsi**on**noy pro**mysh**lennosti*) order dated 1st September 1951. The type was built by five plants – No.1 in Kuibyshev (starting in late 1951), No.21 in Gor'kiy, No.31 in Tbilisi (February 1953), No.126 in Komsomol'sk-on-Amur (late 1952) and No.153 in Novosibirsk. In Gor'kiy the MiG-17 was known as *izdeliye* 54; the product code in Kuibyshev was *izdeliye* 40.

Production MiG-17s delivered to first-line units had slightly lower performance than the SI-01 and SI-02. Maximum speed at 2,000 m (6,560 ft) was 1,094 km/h (679 mph); the aircraft climbed to 5,000 m (16,400 ft) and 10,000 m (32,810 ft) in 2.5 and 6.6 minutes

A MiG-17PF interceptor. This view shows the radar nose, the modified windshield, the afterburner nozzle and the large airbrakes.

respectively, and the service ceiling was 14,500 m (47,579 ft). Range was 1,290 km (801.5 miles) on internal fuel, increasing to 2,060 km (1,280 miles) with two 400-litre drop tanks. Early production MiG-17s had an empty weight of 3,800 kg (8,380 lb) and an MTOW of 6,070 kg (13,380 lb).

Various improvements were progressively introduced, such as a new ejection seat (in late 1953), a rear-view periscope and larger airbrakes with an area of 0.88 m^2 (9.46 sq ft) in September 1952. The avionics suite was also upgraded. The ASP-3N gunsight was introduced at the same time as on the MiG-15*bis*. Later, the MiG-17 received the Sirena-2 RWR and a new AGI-1 artificial horizon specially developed for fighters (*aviagori**zont** istre**bi**tel'nyy*) which did not tumble during violent manoeuvres (introduced in 1954).

The MiG-17 became a worthy successor to the MiG-15*bis*, replacing it in first-line service in the Air Force and the PVO. The new fighter received the ASCC reporting name *Fresco*; later, when other versions of the MiG-17 became known in the West, this was changed to *Fresco-A*.

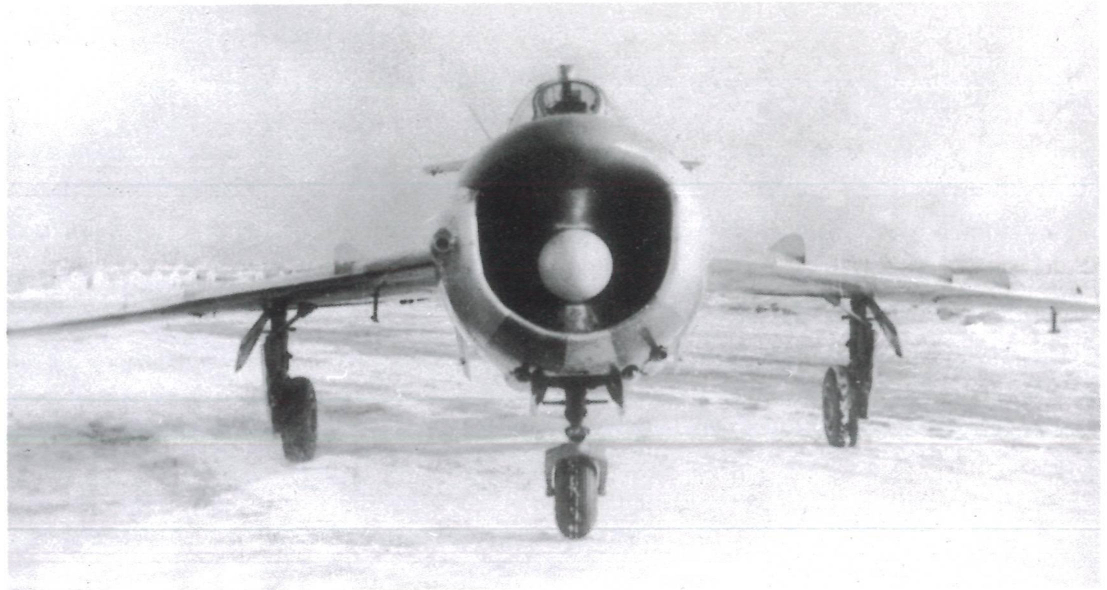
The MiG-17 was very much a 'pilot's aeroplane' and capable of performing complex aerobatics; however, pilots noted that somewhat bigger control inputs were required than on the MiG-15. Acceleration after take-off was slightly better and the airbrakes enabled wingovers to be performed throughout the speed range and at altitudes up to 14,000 m (45,930 ft). The MiG-17 was steady at high altitude and could make turns with only a minor loss of altitude even at its service ceiling.

Mikoyan MiG-17F tactical fighter (*izdeliye* SF, *Fresco-C*)

As such, the VK-/VK-1A turbojet powering the MiG-17 had no reserves for further uprating. Neither engine pressure ratio nor turbine temperature could be increased any further. Hence in 1949 the Central Institute of Aero Engines (TsIAM – *Tsen**trahl'**nyy insti**toot** aviatsi**on**novo mo**tor**ostro**yen**iya*) and OKB-155 began investigating the possibility of fitting an afterburner to the VK-1A. The resulting VK-1F engine (*for**see**rovannyy* – afterburning) completed bench tests in the summer of 1951, showing a rating of 2,600 kgp (5,730 lbst) dry and 3,380 kgp (7,450 lbst) reheat – an increase of about 25% over the VK-1A.

The MiG-17 powered by the VK-1F engine received the manufacturer's designation *izdeliye* SF – that is, *izdeliye* S *s for**sah**zhem* (with afterburning). The aft extremity of the fuselage was cut away to expose the convergent-divergent afterburner nozzle and the redesigned airbrakes with an area of 0.64 m^2 (6.88 sq ft) and repositioned actuators were fitted. The fuel system was also modified, since fuel consumption and fuel flow increased sharply when the afterburner was engaged.

The prototype was converted from a Gor'kiy-built MiG-15*bis*, using airframe components of the second pre-production MiG-17. It was rolled out on 20th September 1951 and made its first flight nine days later with Mikoyan OKB test pilot Aleksandr N. Chernoboorov at the controls. On 31st January 1952 the aircraft was handed over to GK NII VVS for state acceptance trials which



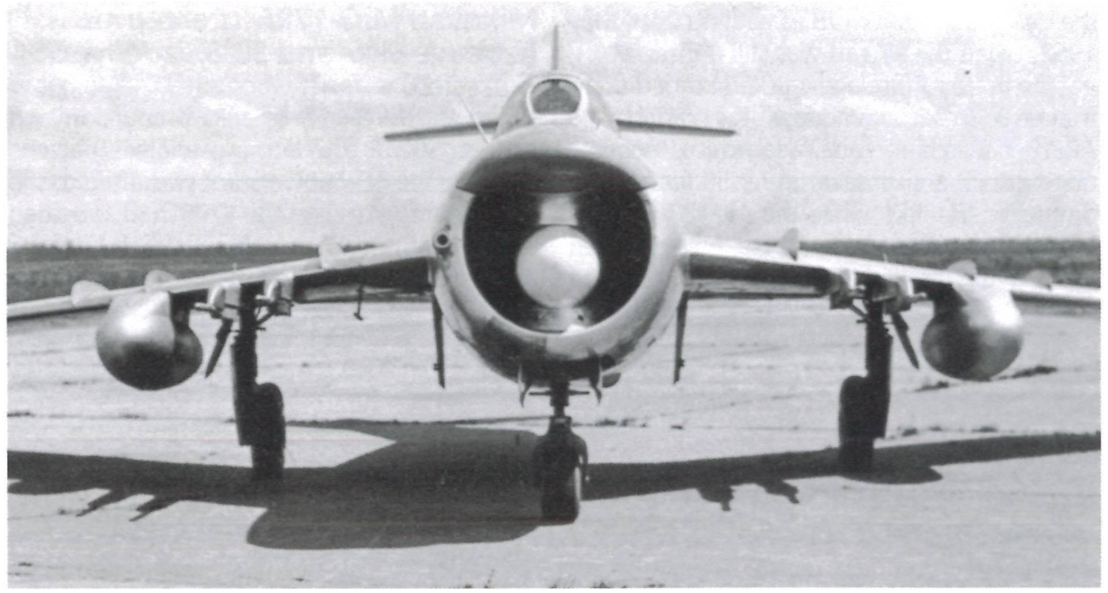
Head-on view of '209 Red', an early-production MiG-17PF with an RP-1 Izumrood-1 radar.

began on 16th February and were completed in June. Test pilots Aleksey G. Solodovnikov and Leonod M. Koovshinov stated exceeding Mach 1 in a shallow dive right away, but going supersonic in the MiG-17 called for tremendous efforts.

The new engine improved the fighter's performance a lot. At full military power the maximum rate of climb was no more than 20 m/sec (3,940 ft/min); in full afterburner it rose to 45 m/sec (8,860 ft/min). The afterburner improved the aircraft's service ceiling and significantly enhanced vertical manoeuvrability in a dogfight. Regrettably, the speed increase in horizontal flight when the afterburner was engaged proved to be small – in fact, at certain altitudes there was no improvement at all.

Despite certain problems with the afterburner, the aircraft was put into production and included into the inventory as the MiG-17F; the NATO codename was *Fresco-C*. In speed, rate of climb and service ceiling the MiG-17F surpassed not only its predecessor but also the best Western fighters in its class. At 12,000 m (39,370 ft), the prototype had a range of 1,160 km (720 miles), increasing to 1,940 km (1,210 miles) with drop tanks; endurance in these conditions was 1 hr 44 min and 2 hrs 52 min respectively.

'09 Blue', a production MiG-17PF fitted with drop tanks. Note the offset gun camera.



Here, by way of comparison, is the MiG-17PFU with four missile rails but no cannons. Slipper tanks are fitted in this instance.

Mikoyan MiG-17P interceptor (*izdeliye* SP-6, *izdeliye* 56/57, *Fresco-B*)

The Mikoyan OKB attached special importance to creating radar-equipped interceptors optimised for night and poor-weather operations. Hence as early as 1952 it began development of the *izdeliye* SP-6 (*pere**khvat**chik* – interceptor) based on the MiG-17 day fighter. The aircraft was equipped with the RP-1 *Izumrood*-1 (Emerald-1) aerial intercept radar (*rahdiopritsel* – radio sight, in the terminology of the time). The NII-17 avionics research institute led by Viktor V. Tikhomirov had begun development of this radar in 1948, mainly as an insurance policy in case the ***Tor**iy* (Thorium) AI radar turned out to be substandard – which it did. The RP-1 provided target search, automatic tracking and attack in the fighter's forward hemisphere (in conjunction with the ASP-3N or ASP-3NM gunsight) and identified the target in conjunction with the IFF system.

The RP-1 was a centimetre-waveband (S-band) radar with separate search and tracking antennas two aerials and two modes of operation: search and aiming (tracking). In search mode the radar had a 12-km (7.46-mile) advertised detection range and a field of view of ±60° in azimuth and +26/–16° in elevation, scanning through the entire field of view in 1.33 sec. Tracking mode was switched on automatically when the target was in a 7° forward cone and at approximately 2 km (1.24 miles) range. At this point, tracking accuracy was 1° and 150 m (490 ft).

The radar featured a cathode-ray tube (CRT) display with a high retention (viewing) time enabling the pilot to observe multiple targets simultaneously; it also showed artificial horizon markers for attitude reference. The CRT was originally viewed through the ASP-3N sight by means of mirrors, though on production aircraft equipped with the RP-1 it was a separate unit.

Interception was performed as follows. Guided by GCI stations, the interceptor entered the area where the intruder was supposed to be and switched on the radar, scanning the forward hemisphere in search mode. When the target was acquired the gunsight showed it as a blip of varying shape – 'T' if the target was above the fighter's flight level, 'inverted T' if it was below the fighter's flight level or '+' if it was on the same level. The pilot was to make sure he was on the same level with the target and close in on it so that the blip crossed the CRT's centreline, entering the radar's autotracking zone. Then the gunsight showed the target as a blip with wings, the wingspan depending on the target's range. When the range was right the computer gave the OK to fire. The radar indicated not only target range and position relative to the fighter but also target motion, enabling the pilot to make an attack manoeuvre and cut across the target's path.

The main advantage of the RP-1 radar was that, unlike the Toriy, it could be easily installed in a single-seat aircraft, since pilot workload was significantly lower than with the Toriy. Also, the MiG-17 was by then in mass production, which meant an interceptor derivative could enter production without too much trouble. This, together with the general dearth of all-weather interceptors, caused the government to order the SP-6 into production under

the designation MiG-17P as early as 24th May 1952, when the aircraft was still unflown.

The forward fuselage was redesigned up to frame 9 to accommodate the radar. The AR-18-1 search antenna radome was incorporated into the air intake upper lip (creating a distinctive 'fat lip'), while the AR-18-16 tracking antenna was housed in a bullet-shaped radome on the air intake splitter. The fixed cockpit windshield was enlarged to accommodate the gunsight and radar display with its rubber sunblind, the bulletproof windscreen being located further forward. Minor changes were made to the front cockpit armour sheet located at frame 4 to fit the recontoured nose.

To compensate for the weight of the radar and maintain CG position, the N-37D cannon on the starboard side was replaced by a lighter NR-23; thus the SP-6 had with three NR-23s with 100 rpg. In overload condition the aircraft could carry two 250-kg (551-lb) bombs. Alternatively, 400-litre drop tanks could be carried. A 6-kW GSR-6000 generator was fitted to cater for the increased power consumption.

Five SP-6 prototypes were built in the summer of 1952, undergoing trials. The MiG-17P interceptor entered production in Gor'kiy and Tbilisi; the product code at the former plant was *izdeliye* 56 (pre-production examples) and *izdeliye* 57.

Some production MiG-17Ps shared the armament of the *Fresco-A/C* (one N-37D cannon and two NR-23 cannons), others carried two or three NR-23s with up to 100 rpg. The earliest production aircraft even had the *Fresco-A*'s original 0.522-m² airbrakes which were later superseded by the 0.88-m² version. The ASP-3N gunsight was later replaced by the intended ASP-3NM. The avionics suite was standard, comprising the OSP-48 ILS, the SRO-1 Bariy-M IFF and the RSIU-3 UHF radio.

The MiG-17P became the first Soviet radar-equipped light interceptor to enter service. The type was operated by the Air Defence Force and the naval air arm. The NATO reporting name was *Fresco-B*; the RP-1 radar also had a NATO codename, *Scan Odd*.

The MiG-17P's service introduction took a lot of effort, since there was as yet no proven method of training pilots in radar intercept techniques. The production RP-1 radar often did not wholly meet the stated performance figures. Theoretically it was to detect a bomber-type target such as a Tu-4 at up to 9.5 km (5.9 miles); in reality the detection range rarely exceeded 8 km (5 miles).

Mikoyan MiG-17PF interceptor (*izdeliye* SP-7 and SP-8, *izdeliye* 58; *Fresco-D*)

When the MiG-17F entered production and enough VK-1F afterburning engines became available the new powerplant was fitted to the MiG-17P as well, as the OKB had intended from the outset. The resulting aircraft bore the in-house designation *izdeliye* SP-7. Its development was ordered by a Council of Ministers directive dated 24th May 1952 and an MAP order dated 2nd June; state acceptance trials were to begin in August.

The prototype was converted from a Kuibyshev-built MiG-17, making its first flight on 8th August 1952 with Gheorgiy A. Sedov at the controls. NII-17 requested an extension of the manufacturer's test programme until mid-December because of development problems with the radar. The tests continued until 16th December 1952. That same day, four months later than intended, the SP-7 was submitted for state acceptance trials which were successfully completed in May 1953. The aircraft received the service designation MiG-17PF (*pere**khvat**chik s for**sah**zhem*, interceptor with afterburning); the product code at the Gor'kiy factory was *izdeliye* 58. Apart from the powerplant and enlarged airbrakes, it differed from the MiG-17P in having a Sirena-2 RWR and an NI-50B navigation display (*navigatsi**on**nyy indi**kah**tor*).

The MiG-17PF showed a marked improvement over its predecessor in top speed and rate of climb. On the other hand, cruising speed and range deteriorated somewhat because of the higher AUW and because the engine's dry rating was 100 kgp (220 lbst) lower. Top speed at 4,000 m (13,120 ft) was 1,121 km/h (696 mph), and service ceiling was 15,850 m (52,000 ft). The fighter could climb to 5,000 m (16,400 ft) and 10,000 m (32,810 ft) in 2.5 and 4.5 minutes respectively. 360° turn time increased to 85 seconds at full military power or 62 seconds in full afterburner, and rate of climb at sea level dropped to 55 m/sec (10,830 ft/min).

Depending on armament fit and fuel quantity, take-off weight was 5,340-5,550 kg (11,770-12,235 lb) in 'clean' condition or 6,069-6,280 kg (13,379-13,840 lb) with drop tanks. In full 'burner the MiG-17PF became airborne in about 600 m (1,970 ft), and landing run with full flaps was 830 m (2,723 ft).

Later, after successfully completing its trials the improved RP-5 Izumrood-2 radar was introduced on Tbilisi-built MiG-17PFs in

December 1955. Outwardly aircraft equipped with the RP-5 could be identified by the rather larger intake centrebody 'bullet' accommodating the bigger tracking antenna. Late-production MiG-17PFs with the new radar had the OKB designation *izdeliye* SP-8.

The MiG-17PF's NATO reporting name was *Fresco-D*.

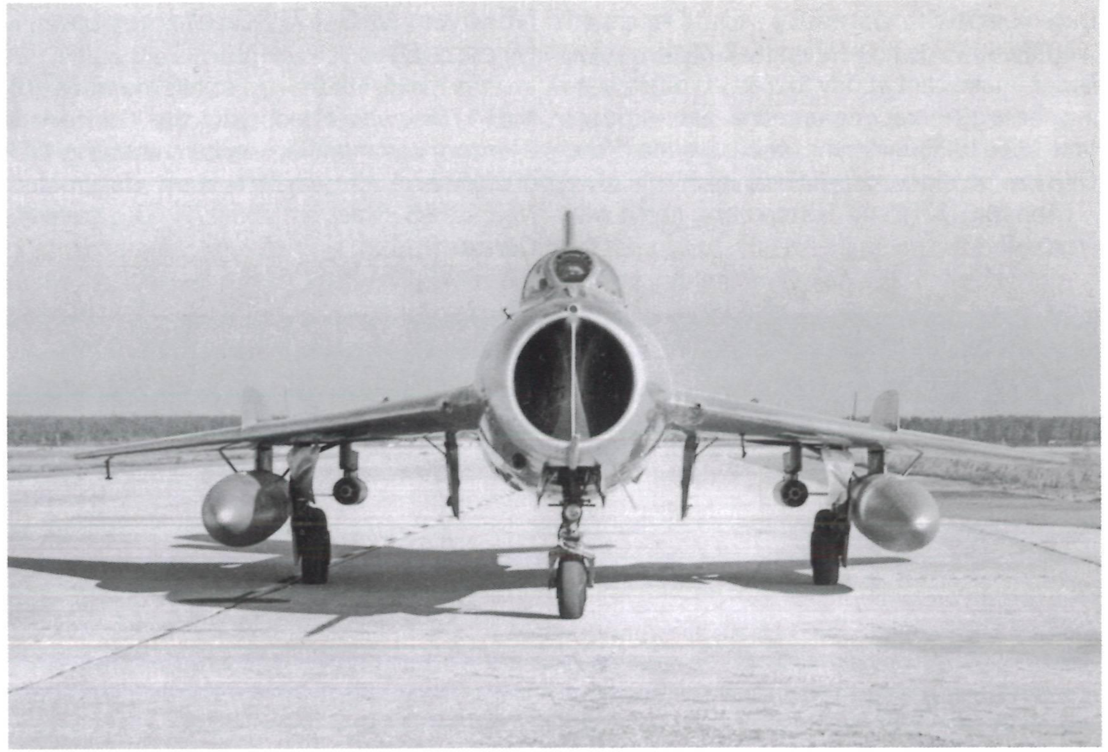
Mikoyan MiG-17PFG interceptor (*Fresco-D*)

In the mid-1950s a small number of MiG-17PFs was fitted with the *Gori**zont**-1* (Horizon) command link system enabling GCI guidance. Such aircraft were designated MiG-17PFG (that is, MiG-17PF [*s sis**tem**oy*] *Gori**zont***).

MiG-15/MiG-17 family specifications

	MiG-15*bis*[1]	MiG-17F	MiG-17P	MiG-17PF	MiG-17PFU
Year of service entry	1950	1952	Second half of 1950s	Second half of 1950s	Late 1950s
Powerplant	VK-1	VK-1F	VK-1A	VK-1F	VK-1F
Thrust, kgp (lbst):					
dry	2,700 (5,950)	2,600 (5,730)	2,700 (5,950)	2,600 (5,730)	2,600 (5,730)
reheat	–	3,380 (7,450)	–	3,380 (7,450)	3,380 (7,450)
Overall length	10.11 m (33 ft 2$\frac{1}{32}$ in)	11.09 m (36 ft 4$\frac{39}{64}$ in)	11.36 m (37 ft 3$\frac{15}{64}$ in)	11.36 m (37 ft 3$\frac{15}{64}$ in)	11.36 m (37 ft 3$\frac{15}{64}$ in)
Wing span	10.08 m (33 ft 0$\frac{55}{64}$ in)	9.628 m (31 ft 7$\frac{3}{64}$ in)	9.628 m (31 ft 7$\frac{3}{64}$ in)	9.628 m (31 ft 7$\frac{3}{64}$ in)	9.628 m (31 ft 7$\frac{3}{64}$ in)
Height on ground	3.7 m (12 ft 1$\frac{43}{64}$ in)	3.8 m (12 ft 5$\frac{39}{64}$ in)	3.8 m (12 ft 5$\frac{39}{64}$ in)	3.8 m (12 ft 5$\frac{39}{64}$ in)	3.8 m (12 ft 5$\frac{39}{64}$ in)
Wing area, m² (sq ft)	20.6 (221.5)	22.6 (243.0)	22.6 (243.0)	22.6 (243.0)	22.6 (243.0)
Empty weight, kg (lb)	3,668 (8,086)	n.a.	n.a.	4,151 (9,151)	4,065 (8,961)
Normal TOW, kg (lb)	5,064 (11,164)	5,354 (11,803)	5,550 (12,235)	5,620 (12,389)	5,703 (12,572)
MTOW, kg (lb)	n.a.	n.a.	6,280 (13,844)	6,552 (14,444)	6,433 (14,182)
Fuel capacity, litres (Imp. gal.):					
internal	1,425 (313.5)	1,410 (315.7)	1,480 (325.6)	1,395 (306.9)	n.a.
with drop tanks	n.a.	2,235 (491.7)	2,280 (501.6)	2,195 (482.9)	n.a.
Top speed, km/h (kts):					
at 5,000 m (16,400 ft)	1,040 (562.16)	1,130 (610.81)	1,085 (586.48)	1,123 (607.0)	1,107/1,059 (598.37/572.43)[2]
at 10,000 m (32,810 ft)	984 (531.89)	1,071 (578.91)	1,033 (558.37)	1,060 (572.97)	n.a.
Rate of climb, m/sec (ft/min):					
at 5,000 m	32.8 (6,550)	65.0 (12,795)	27.0 (5,315)	55.0 (10,826)	n.a.
at 10,000 m	18.6 (3,660)	38.4 (7,559)	15.0 (2,952)	32.3 (6,358)	n.a.
Time to height, min.:					
to 5,000 m	2.1	2.1	2.5	2.5	n.a.
to 10,000 m	5.45	3.7	6.6	4.5	4.8
to 15,000 m (49,210 ft)	n.a.	7.4	n.a.	9.8	n.a.
Service ceiling, m (ft):					
at full military power	15,400 (50,525)	15,100 (49,540)	14,500 (47,572)	14,450 (47,408)	n.a.
in full afterburner	–	16,470 (54,035)	–	16,300 (53,477)	15,650 (51,345)
Range at 10,000 m (32,810 ft), km (miles):					
on internal fuel	1,200 (745)	1,080 (670)	1,290 (801)	1,100 (683)	n.a.
with drop tanks	1,510 (937)	1,670 (1,037)	1,900 (1,180)	1,730 (1,074)	1,850 (1,149)
Take-off run, m (ft)	n.a.	590 (1,804)	805 (2,641)	730-930 (2,395-3,050)	n.a.
Landing run, m (ft)	n.a.	n.a.	885 (2,903)	885 (2,903)	n.a.
Armament:					
cannons	1 x N-37, 2 x NR-23	1 x N-37D, 2 x NR-23	1 x N-37D[3], 2 x NR-23	1 x N-37D, 2 x NR-23	–
missiles	–	–	–	–	4 x RS-1-U

1. Late 1951 production
2. At 4,000 m (13,120 ft)
3. Some MiG-17Ps had a third NR-23 cannon instead of the N-37D



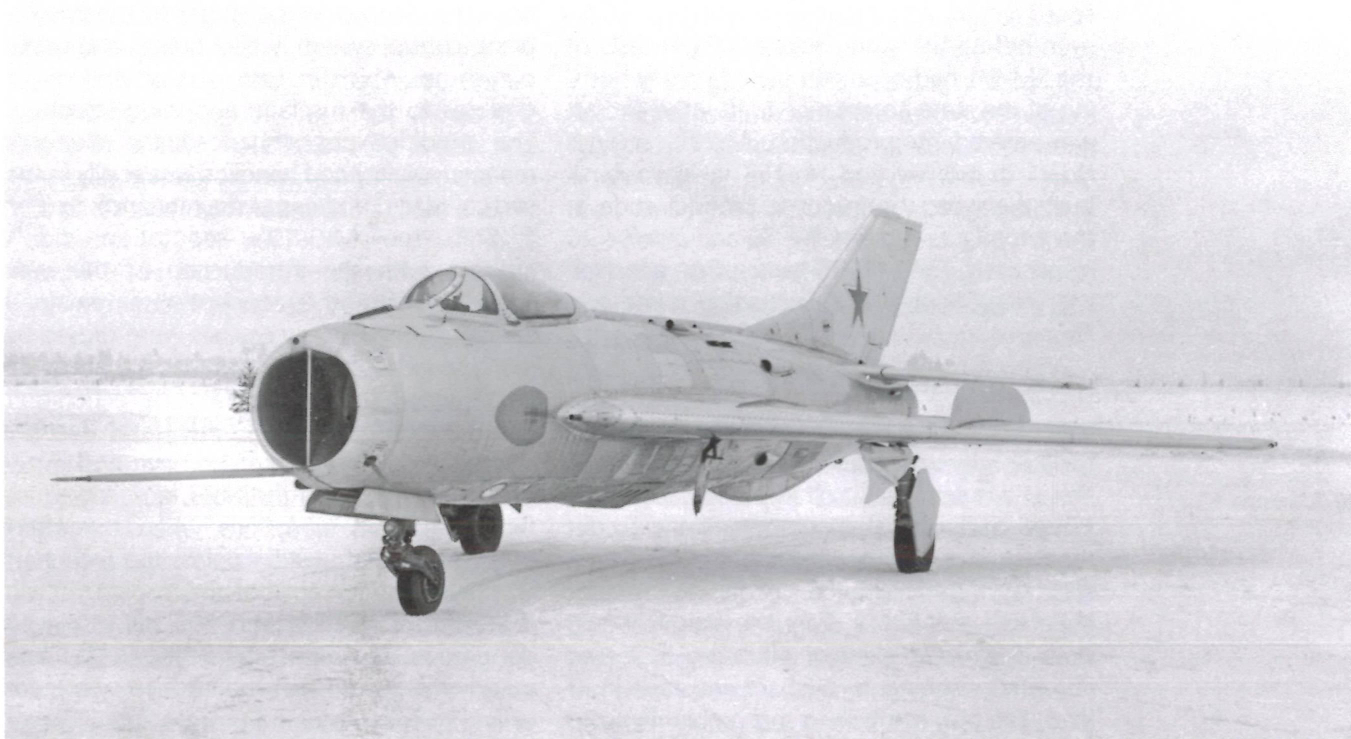
Head-on view of a MiG-19S carrying 760-litre (167.2 Imp gal) drop tanks and ORO-57K rocket pods.

Mikoyan MiG-17PFU interceptor (*izdeliye* SP-15, *Fresco-E*)

From an early stage the Mikoyan OKB envisaged air-to-air missiles for the MiG-17P but their development turned out to be a lengthy process. Hence the first production interceptor version had to make do with cannons. However, when the MiG-19P supersonic interceptor (see below) entered production in 1955, MiG-17PF production began gradually winding down. MAP's OKB-2 led by Pyotr D. Grooshin had completed development of the K-5 AAM. The K-5 (alias S-1-U) weapons system comprised the missiles proper, four APU-3 launch rails (*aviatsi**on**naya pooskovaya oostanovka* – aircraft-mounted launcher) and the RP-5 Izumrood-2 radar suitably modified to act as a fire control radar. It was designed to destroy slow and sluggish targets (that is, heavy bombers) in any weather, day and night. The missile had semi-active radar homing (SARH). When the aircraft came within auto-tracking range of the target and achieved a lock-on, the pilot took aim by placing the reticle of the ASP-3NM gunsight over the target blip and fired. For a second the missile flew in autostabilisation mode, then entered the radar beam and became controllable, following the beam's equisignal line. If the missile strayed from this line the control system deflected the rudders and made course corrections. 13 to 23 seconds after launch the missile's self-destructor detonated the warhead. By the time the solid rocket motor burned out the missile was travelling at 800 m/sec (2,880 km/h or 1,556 kts); maximum launch range was 3 km (1.86 miles).

In keeping with Council of Ministers directive No.2543-1224 dated 30th December 1954 the five MiG-17P (SP-6) prototypes had been converted into testbeds for the K-5, with good results. Hence, when the Powers That Be contemplated introducing the K-5 weapons system on the *Fresco-D*, it was found more expedient to retrofit it to existing aircraft with the old RP-1 radar than to build new ones. NII-17, the radar's developer, was tasked with giving the RP-1 missile guidance capability. This upgrade programme was completed in short order; the result was the RP-1-U, the suffix letter standing for *oopravleniye* [*snaryadami*] – missile guidance. Similarly, MiG-17PFs retrofitted with the K-5 weapons system and the upgraded radar received the designation MiG-17PFU. The NATO reporting name was *Fresco-E*. Conversion work was undertaken at the Gor'kiy aircraft factory in 1956; a total of 40 *Fresco-Ds* was modified.

Before entering service the upgrade was tested by the Mikoyan OKB on a prototype known in-house as *izdeliye* SP-15. Again, the MiG-17PFU had four pylons for carrying RS-1-U missiles, as the K-5 was known in production form (NATO codename AA-1 *Alkali*). Apart from the powerplant, airbrakes and radar type, the 'production' version also differed from the SP-6 in lacking cannons.

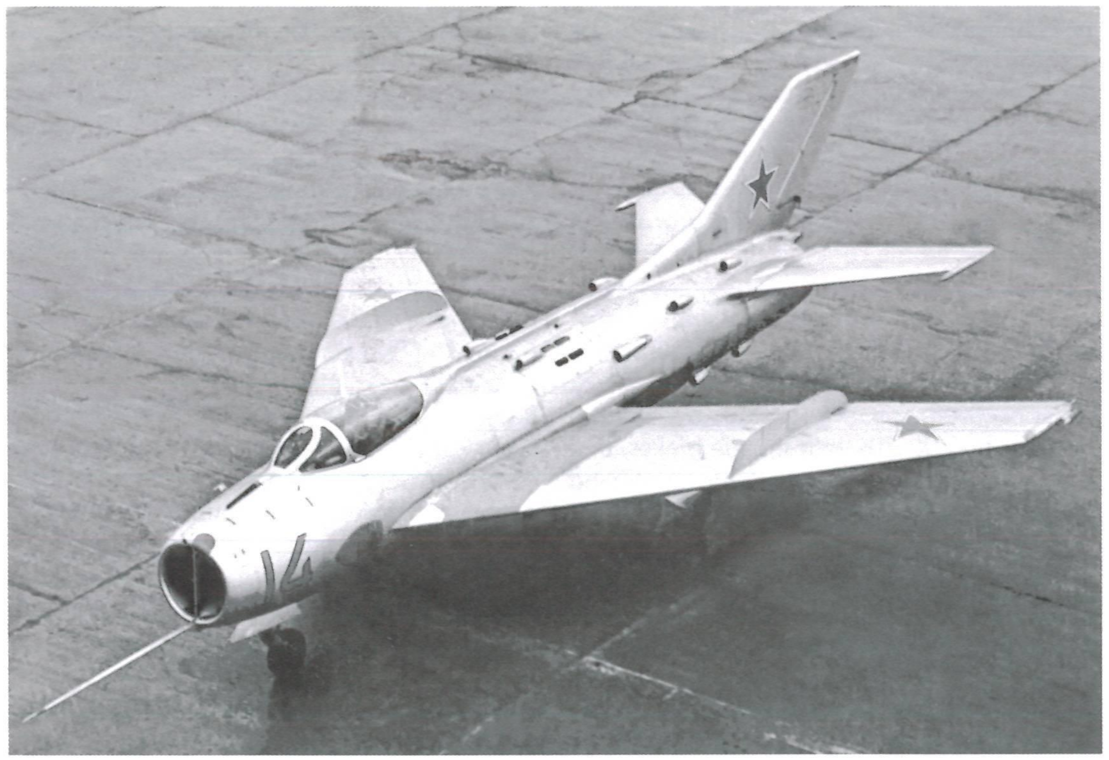


Three-quarters front view of an early MiG-19S with NR-23 cannons.

Even though the S-1-U weapons system became operational ahead of other Soviet air-to-air missiles, it no longer met the growing requirements. Hence the MiG-17PFU found only limited use. Still, the type soldiered on with the PVO for a long time; in addition to its primary role, it was used as a trainer for MiG-19PM *Farmer-D* pilots during the late 1950s.

Mikoyan MiG-19S tactical fighter (*izdeliye* SM-9/3; *izdeliye* 61, *izdeliye* 26; *Farmer-C*)

First flown on 5th February 1954, the MiG-19 (SM-9) was the first truly supersonic Soviet fighter to reach production. In one of the first flights it reached Mach 1.33 in level flight and Mach 1.44 in a shallow dive from 10,600 m (34,780 ft), thus setting an unofficial world



'14 Blue', an example of the MiG-19SV high-altitude interceptor optimised for PVO duties. Note the additional cooling air scoops on the rear fuselage for the hotter RD-9BF engines and the absence of the wing cannons (the armament was restricted to one cannon in the fuselage nose).

speed record. As early as 17th February 1954 – even before the manufacturer's flight tests of the SM-9/1 had been completed, to say nothing of the state acceptance trials – the aircraft was ordered into production. Aircraft factories No.21 in Gor'kiy and No.153 in Novosibirsk built the type; the in-house product code at the two plants was *izdeliye* 59 and *izdeliye* 25 respectively. The MiG-19 *sans suffixe* achieved IOC in 1955; the NATO reporting name was *Farmer-A*.

The original model had conventional fixed stabilisers and inset elevators. However, at a very early stage it became apparent that elevator authority was insufficient beyond Mach 1. This also manifested itself in the so-called *pod**khvat*** ('pick-up') phenomenon. Trying to get the desired response, pilots would haul on the stick with greater force, increasing elevator deflection and hence drag; the aircraft would slow down and elevator efficiency increased abruptly, resulting in a sharp increase in G load. The only solution to this problem was to fit all-movable stabilisers (stabilators). These were introduced on the SM-9/2 and SM-9/3 prototypes, which entered flight test in June 1954 and 13th September 1955 respectively.

Also in September 1955, the Gor'kiy and Novosibirsk aircraft factories started gearing up to build the new version of the MiG-19 to SM-9/3 standard; this had the service designation MiG-19S (for [***tsel'****nopovo****rot****nyy*] *stabili**zah**tor* – all-movable stabiliser). However, it was not until June 1956 that the production MiG-19S superseded the original *Farmer-A* on the assembly lines. In Gor'kiy the MiG-19S had the internal designation *izdeliye* 61, while the product code at Novosibirsk was *izdeliye* 26.

Apart from the stabilators, the MiG-19S introduced a host of other changes. Two separate hydraulic systems were used, one of which powered the control actuators. The two 1.04-m² (11.18-sq ft) lateral airbrakes were augmented by a ventral airbrake with an area of 0.45 m² (4.8 sq ft). To give the fighter a bigger punch, the *Farmer-A*'s three NR-23 cannons were soon replaced by 30-mm (1.18 calibre) NR-30s with muzzle brakes, and changes were made to the gun mounts and other associated systems. Two wing hardpoints permitted carriage of 250-kg (551-lb) bombs or rocket pods.

The avionics suite included an SRD-3 Grad (Hail) gun ranging radar (replacing the *Farmer-A*'s SRD-1), which was linked to an ASP-5N gunsight, and an RSIU-4 Doob (Oak) UHF radio replacing the earlier RSIU-3. Additionally, the MiG-19S incorporated changes to the powerplant, control system, wheel brakes and brake parachute, which in turn necessitated major changes to the fuselage and wing structure. The modifications enhanced the aircraft's manoeuvrability and handling, especially in the vertical plane, and eased maintenance.

Still, the MiG-19's reputation didn't improve with the introduction of the new model because the accident rate remained alarmingly high. Many crashes were caused by faulty control system hydraulics that could cause uncommanded stabilator deflection and loss of control, often with fatal results. Hydraulic leaks in the engine bays, and especially fuel leaks from the No.3 tank, led to in-flight fires and explosions when the afterburners were engaged – unless the tech staff was lucky enough to spot the trouble. To top it all, the production MiG-19S still displayed dangerous spinning characteristics. Pilots quickly discovered that the MiG-19 was quite willing to spin, requiring prompt and accurate recovery action; it was an unforgiving aircraft that did not tolerate hesitation or fussy actions. Two spin research programmes were undertaken in 1958 to remedy this – at LII and at GK NII VVS. These tests culminated in a special spin recovery technique which was gradually mastered by service pilots flying the type.

Meanwhile, more improvements were developed for the MiG-19S. In 1956 the rear fuselage was 'cleaned up' aerodynamically. An improved hydraulic system featuring new twin-chamber control surface actuators was developed in 1957; to stop the tailplane actuator from overheating it was placed in a hermetically-sealed capsule. The APS-4MD electric emergency tailplane actuator, which had more than twice the speed of the original APS-4, was fitted to new-build MiG-19s from 1958 onwards. In 1957 the number of ORO-57K rocket pods was increased to four, with a total of 32 ARS-57M FFARs.

An NI-50IM navigation display was fitted for determining the aircraft's position at altitudes up to 20,000 m (65,620 ft) and speeds up to 2,000 km/h (1,242 mph), computing the distance covered by the aircraft. Another navigation aid developed for the MiG-19S, the Svod (Dome) short-range radio navigation (SHORAN) system, gave it limited all-weather capability by automatically determining the azimuth and distance to ground beacons. It was fitted as part of a navigation suite including the SO-D ATC transponder and the GIK-1 compass.

In the mid-1950s Air Force interest in the MiG-19 began to wane. Quite apart from the numerous defects, the military were apparently turned off by the fact that the *Farmer* was only a little faster than the British and American bombers it was to intercept, and the lack of a single automated GCI system did not help either. In 1956 the Air Force ordered only 400 MiG-19s from the aircraft industry, and they were considered an interim type until new supersonic fighters capable of reaching speeds of 1,700-1,900 km/h (1,055-1,180 mph) and a service ceiling up to 20,000 m (65,620 ft). However, the mounting international tension and the delays in the service entry of newer and faster jets forced a change of plans, and almost 1,000 MiG-19s fighters had been completed by February 1957.

The NII-2 research institute played a crucial part in curing the MiG-19S's teething troubles. In 1956, jointly with TsIAM, it developed the KS system which automatically throttled back the engines when the cannons were fired or rockets launched, thereby preventing engine surge. NII-2 also designed the AKO-2 automatic recoil force compensator (*avto**maht** kompen**sah**tsiï ot**dah**chi*), which prevented pitch oscillations caused by firing the cannons.

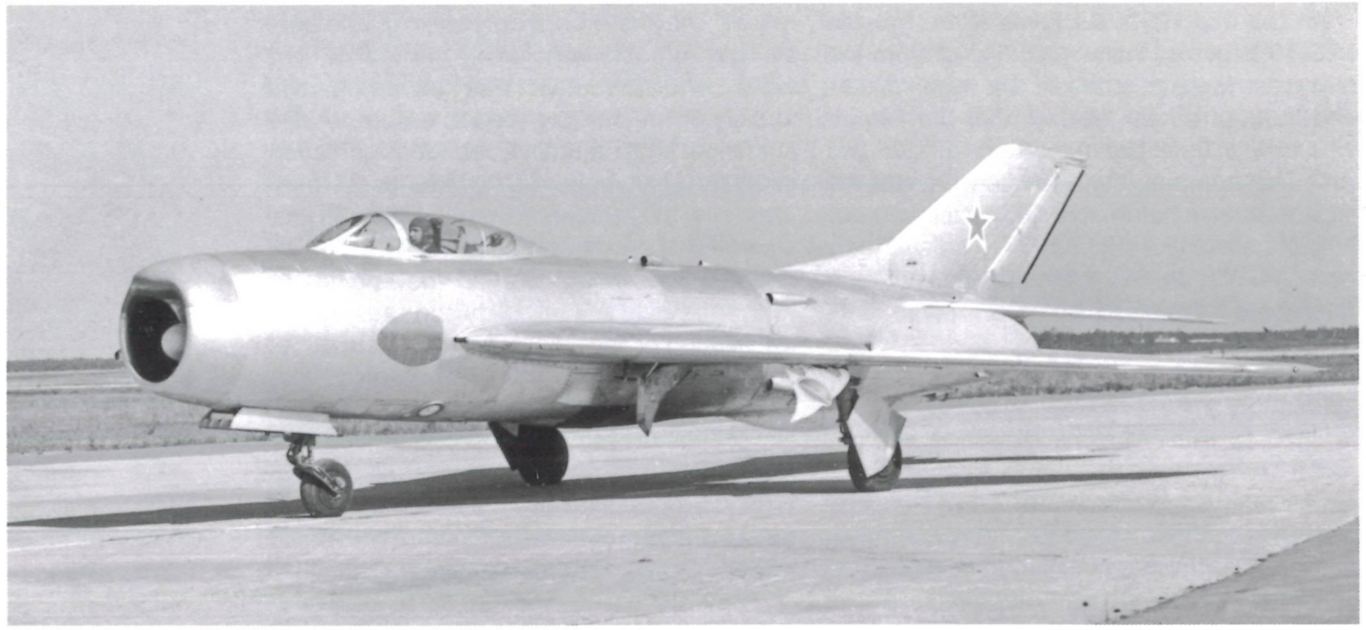
Mikoyan MiG-19SV interceptor (*izdeliye* SM-9V, *Farmer-C*)

No sooner had the MiG-19 and MiG-19S entered service than the NATO began sending reconnaissance balloons *en masse* across the Soviet borders, followed by Boeing RB-47 Stratojet high-altitude reconnaissance aircraft. Much the worse for wear, Soviet intelligence sources reported that Lockheed was working on a reconnaissance aircraft capable of flying at 25,000 m (82,020 ft) – the U-2. No Soviet aircraft of the time could cope with intruders flying that high. Therefore, the Council of Ministers ordered the Mikoyan OKB to design and build a lightened high-altitude interceptor version of the *Farmer-C* designated MiG-19SV (*vy**sot**nyy* – high-altitude) with a service ceiling of 20,000 m. 100 such aircraft were to be built in 1956 and retrofitted with a liquid-fuel rocket booster.

Known in-house as *izdeliye* SM-9V, the MiG-19SV was powered by experimental 3,800-kgp (8,380-lbst) RD-9BF afterburning turbojets (F = *for**see**rovannyy* – uprated) with fixed-area nozzles of increased diameter instead of RD-9Bs rated at 2,600 kgp (5,730 lbst) dry and 3,250 kgp (7,160 lbst) reheat. The afterburner outer casings and nozzle control actuators were deleted to cut weight; the afterburners also had new igniters and a rich fuel mixture feed to ensure reliable ignition at high altitude. Continuous operation in afterburner mode was limited to 25 minutes. Dry thrust was increased 10%. All this increased the service ceiling by 500-700 m (1,640-2,300 ft) but pushed the engines to their limit, reducing reliability and causing critical heating of the adjacent airframe structure. To alleviate the latter, the rear fuselage featured hollow heat shields and eight additional air scoops (these extra scoops were the MiG-19SV's main external recognition feature). Changes were also made to the fuel system, including a new fuel pump with 20% higher output in afterburner mode.

The radio altimeter, brake parachute, fuselage-mounted cannon and armoured seat back were removed and the ammo supply of the wing cannons was reduced to 50 rpg; this gave a weight saving of 230 kg (510 lb). To further cut weight and increase the service ceiling, other equipment could be removed, even such items as two of the oxygen bottles, the de-icing system and the engine fire extinguisher. The ASP-5N computing gunsight was replaced by a simple PKI-1 collimator sight and the Nos. 3 and 4 fuel tanks would remain empty. In this case the weight saving would be 472 kg (1,040 lb) and the take-off weight would be 6,869 kg (15,143 lb). To make up for the lack of the brake parachute the standard KT-37 mainwheels with drum brakes were replaced by KT-61 wheels with cerametallic disc brakes.

The MiG-19SV's mission required additional safety measures and life support equipment. The latter included the KKO-1 oxygen system with increased oxygen pressure and the VSS-04A pressure suit helping the pilot survive an ejection at high altitude and speed. Test pilots Konstantin K. Kokkinaki and Vladimir A. Nefyodov tested the suit, and the results were disappointing: the suit was poorly ventilated and bulky, impairing the pilot's movements. Soon, however, the much-improved VKK-2 pressure suit (*vy**sot**no-kompen**see**ruyushchiy kos**tyum*** – high-altitude compensating suit) was developed; it did not complicate flying in normal mode but the suit inflated instantly In the event of decompression. The new suit was tested by Mikoyan OKB pilots Gheorgiy A. Sedov, Konstantin K. Kokkinaki and Gheorgiy K. Mosolov, as well as Air Force test pilots Stepan A. Mikoyan,



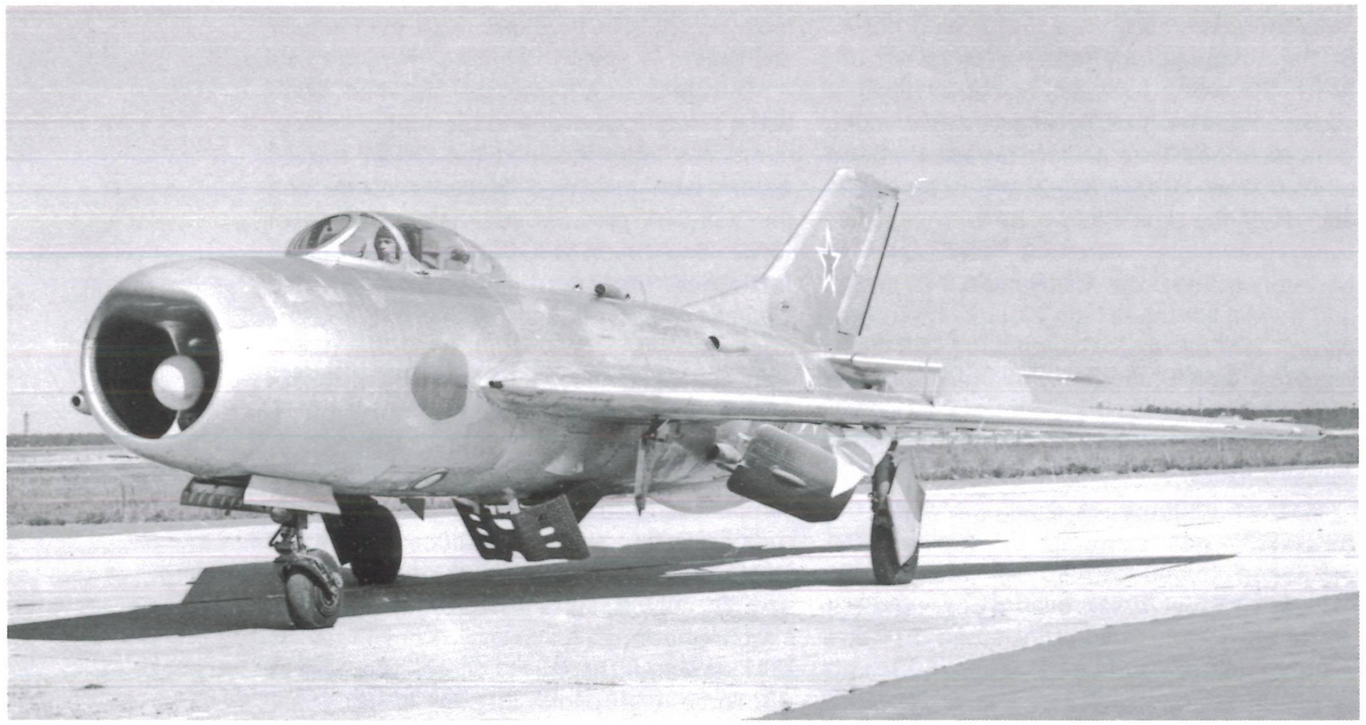
The MiG-19P had the same radar as the MiG-17PF and hence the same front end treatment.

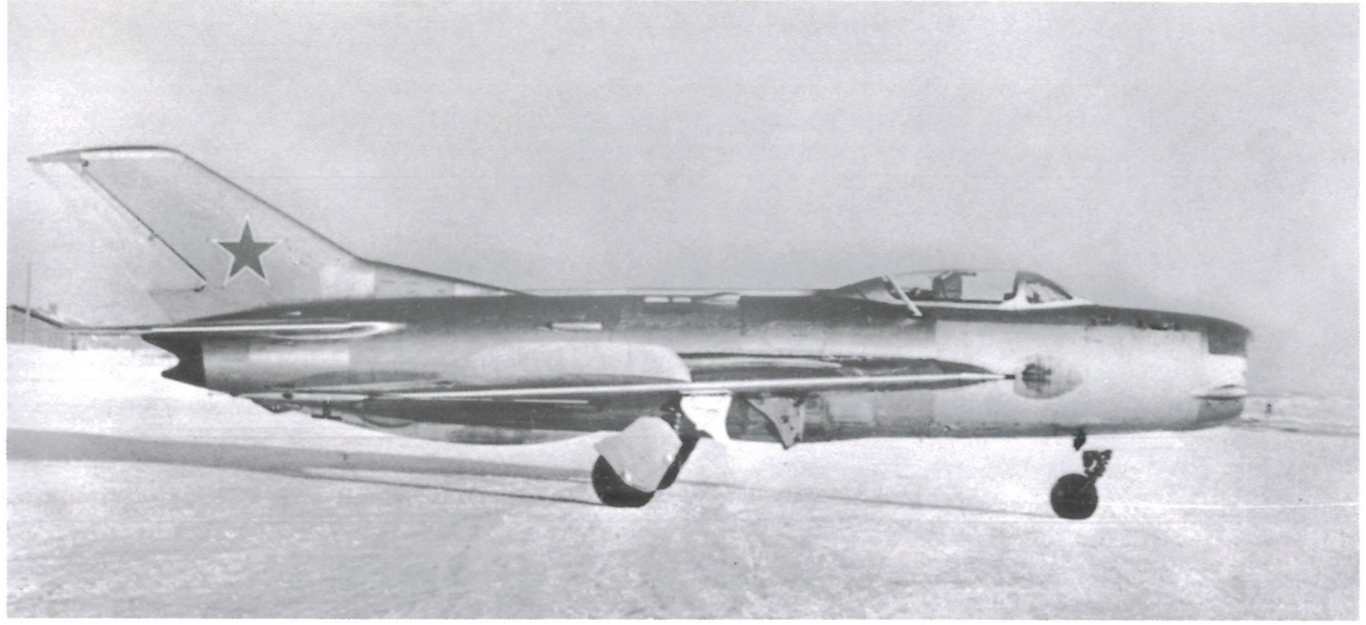
Valentin P. Vasin and Vladimir S. Il'yushin and entered production with minor modifications, staying in the inventory until the early 1990s. It enabled the pilot to work normally at altitudes up to 24,000 m (78,740 ft).

The two MiG-19SV prototypes completed in June 1956 were converted from late-production *Farmer-As*. The manufacturer's flight tests were performed by Mosolov and Nefyodov, whereupon the aircraft were turned over to NII VVS. The SM-9V had a service ceiling of 18,500 m (60,695 ft) – considerably short of the stipulated 20,000 – and a top speed of 1,572 km/h (976 mph) or Mach 1.48 at 11,000 m (36,090 ft). On 6th December 1956, NII VVS test pilot Nikolay I. Korovushkin set an altitude record in one of the SM-9V prototypes, attaining 20,740 m (68,040 ft) in a zoom climb.

The prototypes retained the old horizontal tail with inset elevators and did not match the project specifications in full, being effectively powerplant testbeds. Hence the first and fourth Gor'kiy-built *Farmer-Cs* were similarly converted to MiG-19SVs, entering flight test in 1956. The MiG-19SV entered limited production at one of the two plants building the *Farmer*. Additionally, a number of stock

This view shows the MiG-19P with all three airbrakes open.





Side view of a MiG-19P with powder stains on the gun blast plates.

Farmer-Cs were converted to this standard. All-up weight was 7,330 kg (16,160 lb) – 230 kg (510 lb) less than the standard *Farmer-C*. The service ceiling was 18,500 m and top speed 1,572 km/h at 10,000 m (32,810 ft).

The RD-9BF engines fitted to production MiG-19SVs had a marginally smaller nozzle diameter (498 mm/$19\frac{39}{64}$ in versus 535 mm/ 21 in on the prototypes). Some aircraft had RD-9BF-1 engines with revised afterburners or RD-9BF-2s uprated to 4,100 kgp (9,040 lbst). Operational experience showed that the main shortcoming of the RD-9BF was its tendency to flame out at altitudes approaching the aircraft's service ceiling.

Mikoyan MiG-19P interceptor (*izdeliye* SM-7, *izdeliye* 62; *Farmer-B*)

On 15th August 1953 the Council of Ministers issued directive No.2181-387 backed up eleven days later by MAP order No.638. These documents tasked the Mikoyan OKB with developing an all-weather interceptor version of the SM-9 (the future MiG-19) in parallel with the basic day fighter; the aircraft was to be submitted for state acceptance trials in July 1954.

The advanced development project (ADP) was completed in December 1953. Known in-house as *izdeliye* SM-7, the interceptor differed from the SM-9 in many respects. Most notably, it was fitted with the RP-1 Izumrood-1 AI radar linked to an ASP-5NM gunsight. The radar installation was similar to that of the MiG-17P, with the characteristic 'fat lip' and bullet-shaped intake centrebody; hence the forward fuselage had to be redesigned and lengthened by 360 mm (1 ft $2\frac{11}{64}$ in). The inlet ducts were recontoured and their cross-section area enlarged.

The cockpit was widened and the instrument panel reconfigured to make room for the radar display. The cockpit armour included a 10-mm ($0\frac{25}{64}$ in) front plate and a 16-mm ($0\frac{5}{8}$ in) rear plate/armoured headrest.

The armament was reduced to two wing-mounted NR-23 cannons with 120 rpg. The aircraft could carry two RO-57-8 FFAR pods with eight ARS-57 rockets apiece or two FAB-250 bombs; a separate AP-57 sight was fitted for aiming these. Two 760-litre (167.2 Imp gal) drop tanks could also be carried. The avionics included an RSIU-3M UHF radio, an ARK-5 ADF, an Oozel IFF interrogator/ transponder and a Sirena-2 RWR. The capacity of the oxygen system was increased to 10 litres (2.2 Imp gal).

The first prototype designated SM-7/1 was powered by AM-9B (RD-9B) engines and had fixed stabilisers with inset elevators; it made its first flight on 28th August 1954. The manufacturer's test programme was completed on 15th December 1954, whereupon the SM-7/1 was submitted for state acceptance trials which continued into 1956.

By then the NR-30 cannon had been selected for the production MiG-19; hence two such cannons with 120 rpg (some documents say 70 rpg) were fitted to the SM-7/1 for state acceptance trials. The standard drop tanks were always only half full with 400 litres (88 Imp gal) each because of the landing gear's structural strength limits.

MiG-19PT '23 Blue' carrying two R-3S IR-homing AAMs outboard of the drop tanks. The cannons appear to have been removed.

The second and third prototypes (SM-7/2 and SM-7/3) differed from the first aircraft in having stabilators powered by a BU-14 hydraulic actuator with an electric backup system. A ventral third airbrake with an area of 0.45 m² (4.8 sq ft) was added, as was a second pair of wing hardpoints. Another difference was that the SM-7/2 had an RP-5 Izumrood-2 radar as fitted to late-production MiG-17PFs. After a brief manufacturer's test programme the aircraft were also turned over to GK NII VVS for state acceptance trials.

The SM-7/3 became the pattern for the production MiG-19P (*pere**khvat**chik* – interceptor) which was built at the Gor'kiy plant in 1955 as *izdeliye* 62. Outwardly production aircraft could be distinguished from the prototypes by the more streamlined centrebody radome; after all, the MiG-19P was faster than the MiG-17P/PF from which the radar had been borrowed. On late-production MiG-19Ps the RP-1 Izumrood-1 radar was replaced by the RP-5 Izumrood-2.

Curiously, the initial production aircraft were still armed with NR-23 cannons (test results notwithstanding), but these were quickly substituted by the intended NR-30s with 70 rpg. The entire ammo supply could be expended in five seconds and maximum accurate firing range was 1,500 m (4,920 ft). The MiG-19P's improved ARU-2V automatic flight control governor made for accurate sighting at up to 15,000 m (49,210 ft) but necessitated a change in aileron mass balancing. In contrast, the ARU-2A fitted to the MiG-19S had a limit of 10,000 m (32,810 ft). Because of the increased take-off weight, smaller 540-litre (118.8 Imp gal) drop tanks had to be used to avoid exceeding the landing gear's structural strength limits.

Early-production MiG-19Ps built in 1955 (c/ns 62210101 through 62210625) had an SRO-1 IFF transponder and the Gorizont-1 command link system. The system guided the aircraft to the target and transmitted coded speed, heading and altitude data to GCI centres via the specially-modified RSIU-3MG Klyon UHF communications radio (the G is a reference to the Gorizont-1 system). Aircraft thus equipped were sometimes referred to as MiG-19PG (for Gorizont), serving with PVO units alongside standard MiG-19Ps.

In 1956 the GCI system was changed; hence aircraft built from c/n 62210626 onwards were equipped with the SRO-2 Khrom (Chromium; NATO *Odd Rods*) IFF transponder and an RSIU-4V Mindal' (Almond) radio, and the Gorizont-1 system was deleted. Both versions featured the OSP-48 ILS. From c/n 62210545 onwards the RD-9B Srs 4 turbojets were replaced by improved Srs 6 engines with a push-button afterburner control system. The MiG-19P was codenamed *Farmer-B* by NATO.

Though the MiG-19P was a major boost to the PVO's intercept capability, it suffered from a spate of new defects which were unknown to the MiG-19S – mostly numerous radar malfunctions.

As noted earlier, the Soviet military began to lose interest in the MiG-19 by the mid-1950s, and this affected the interceptor version as well: only 200 were ordered. The MiG-19P was slightly inferior in performance to the MiG-19S, having a maximum speed of 1,432 km/h (889 mph), a service ceiling of 17,250 m (56,590 ft) and climbing to 10,000 m (32,810 ft) in 1.2 minutes. Range with drop tanks did not exceed 1,520 km (940 miles).

Mikoyan MiG-19PM interceptor (*izdeliye* SM-7/2M, *izdeliye* 65; *Farmer-D*)

In January 1956 the first prototype MiG-19P (SM-7/1) was retrofitted with the K-5M missile system, entering trials as the SM-7/1M; six more aircraft were similarly modified in 1957. The aircraft had four wing pylons for carrying RS-2-U AAMs; no cannons were fitted. The avionics suite included an RP-2-U radar coupled with an ASP-5N-V5 sight. The DGMK-3 gyro magnetic compass was replaced by a GIK-1 gyro flux gate compass, and an OSP-48P ILS featuring a more sophisticated MRP-56P marker beacon receiver was fitted.

The state acceptance trials lasted a full year – from 14th October 1956 to 23rd October 1957. Test pilot Stepan A. Mikoyan performed most of the flights at GK NII VVS. The trials were successful and the aircraft was cleared for production. The Mikoyan OKB handed over the SM-7/2M's manufacturing drawings to the Gor'kiy plant in 1957 and the entered production as the MiG-19PM or *izdeliye* 65; about 250 were built.

Avionics reliability on the MiG-19PM turned out to be even worse than on the MiG-19P and performance was nowhere near as good as that of the MiG-19S. Because of the draggy external stores top speed dropped to 1,250 km/h (776 mph). This, and the frequent control system malfunctions, certainly did not help the type's reputation, though reliability did improve in the closing stages of the MiG-19PM's career.

Mikoyan MiG-19PML interceptor

After being retrofitted with the *La**zoor'*** (Prussian Blue) command link system in the 1960s some MiG-19PM interceptors were redesignated MiG-19PML.

A MiG-19PM carrying drop tanks but no missiles. Note the absence of the unnecessary gun blast plates.

MiG-19 family specifications

	MiG-19S	MiG-19SV	MiG-19P	MiG-19PM
Year of service entry	1955	1956	1956	1957
Powerplant	RD-9B	RD-9BF	RD-9B	RD-9B
Thrust, kgp (lbst):				
dry	2,600 (5,730)	2,600 (5,730)	2,600 (5,730)	2,600 (5,730)
reheat	3,250 (7,160)	3,300 (7,275)	3,250 (7,160)	3,250 (7,160)
Wingspan	9.00 m (29 ft 6$\frac{21}{64}$ in)	9.00 m (29 ft 6$\frac{21}{64}$ in)	9.00 m (29 ft 6$\frac{21}{64}$ in)	9.00 m (29 ft 6$\frac{21}{64}$ in)
Length:				
less pitot	12.54 m (41 ft 1$\frac{45}{64}$ in)	12.54 m (41 ft 1$\frac{45}{64}$ in)	13.025 m (42 ft 8$\frac{51}{64}$ in)	13.025 m (42 ft 8$\frac{51}{64}$ in)
with pitot	14.64 m (48 ft 0$\frac{3}{8}$ in)	14.64 m (48 ft 0$\frac{3}{8}$ in)	–	–
Height on ground	3.885 m (12 ft 8$\frac{61}{64}$ in)	3.885 m (12 ft 8$\frac{61}{64}$ in)	3.885 m (12 ft 8$\frac{61}{64}$ in)	3.885 m (12 ft 8$\frac{61}{64}$ in)
Wing area, m² (sq ft)	25.16 (270.53)	25.16 (270.53)	25.16 (270.53)	25.16 (270.53)
Empty weight, kg (lb)	5,172-5,447 (11,402-12,008)	n.a.	n.a.	5,660 (12,477)
Take--off weight, kg (lb):				
normal (in 'clean' condition)	7,560 (16,660)	n.a.	7,730 (17,040)	7,880 (17,370)
maximum (with drop tanks)	8,662 (19,096)	n.a.	9,100 (20,060)	9,400 (20,720)
overload (w. tanks & FFAR pods)	8,832 (19,470)	n.a.	n.a.	n.a.
Top speed at 10,000 m (32,810 ft), km/h (mph)	1,452 (901)	1,500 (931)	1,432-1,445 (889-897)	1,230 (764)
Service ceiling, m (ft):				
at full military power	15,600 (51,180)	n.a.	n.a.	n.a.
in full afterburner	17,500-17,900 (57,410-58,730)	18,500 (60,695)	17,250 (56,590)	16,600 (54,460)
Time to service ceiling, min:	10.0	n.a.	7.5	8.0-9.0
Range, km (miles):				
in 'clean' condition	1,400 (869)	n.a.	1,100 (683)	n.a.
with drop tanks	2,200 (1,366)	n.a.	1,800-1,910 (1,118-1,186)	1,800-1,910 (1,118-1,186)
Endurance:				
in 'clean' condition	1 hr 43 min	n.a.	n.a.	n.a.
with drop tanks	2 hrs 38 min	n.a.	2 hrs 18 min	n.a.
Take-off run, m (ft):				
w. drop tanks/at full mil power	900 (2,957)	n.a.	n.a.	n.a.
in 'clean' condition/in full 'burner	515 (1,689)	n.a.	n.a.	n.a.
Landing run, m (ft):				
with brake parachute	610 (2,001)	n.a.	n.a.	n.a.
without brake parachute	890 (2,919)	n.a.	n.a.	n.a.
Armament:				
cannons	3 x NR-30 w. 201 rounds	1 x NR-30	2 x NR-30 w. 146 rounds	–
rockets	2-4 FFAR pods w. 16-32 rockets	–	2-4 FFAR pods w. 16-32 rockets	–
missiles		–	–	4 x RS-2-U AAMs

Mikoyan MiG-19P missile upgrades

As PVO fighter units received air-to-air missiles a small number of early MiG-19Ps was retrofitted with missile rails at aircraft repair plants during the early 1960s. Unlike the MiG-19PM, these aircraft carried only two RS-2-US AAMs.

Mikoyan MiG-21PF interceptor (*izdeliye* 76, *Fishbed-D*)

First flown in 1960, the MiG-21F-13 *Fishbed-C* (*izdeliye* 74) was the first missile-armed version of the type carrying two R-3 IR-homing AAMs – a reverse-engineered version of the AIM-9B Sidewinder, which the Soviet Union had obtained via China in 1958. However, the MiG-21F-13 was limited to operations in visual meteorological conditions (VMC), since the SRD-5M ranging radar did not give all-weather/night capability. Therefore, as early as 24th July 1958 the Soviet Council of Ministers issued directive No.831-398, backed up by State Committee for Aviation Hardware (GKAT, ex-MAP) order No.304 of 2nd August, which tasked the Mikoyan OKB with developing a version of the MiG-21 capable of operating in instrument meteorological conditions (IMC) in 1959. It was to be armed with two AAMs and equipped with a TsD-30 fire control radar having a detection range of 18-20 km (11-12.4 miles) against a medium bomber; this radar was already fitted to the production Sukhoi Su-9 interceptor as the RP-9.

Bearing the provisional service designation MiG-21P (*pere**khvat**chik* – interceptor) and the manufacturer's designation Ye-7, the aircraft had a longer nose with an air intake of appreciably greater diameter to accommodate the bulky radar. The three-position ogival air intake centrebody of the MiG-21F gave way to a much larger centrebody of simple conical shape accommodating the radar antenna; its position was adjusted smoothly by a synchro system, depending on the flight mode and engine speed. On the MiG-21F-13 the number of cannons had already been reduced from the MiG-21F's two to one; now, the higher take-off weight forced the designers to eliminate the cannons altogether.

The aerial intercept weapons system based on the Ye-7 was designated MiG-21P-13. The aircraft was to be vectored towards the target by means of the Vozdukh-1 GCI system; hence the Ye-7's avionics suite included Lazoor' data link equipment. The interceptor also featured a KSI compass system developed specifically for fighters (*koorso**va**ya sis**tem**a istre**bit**el'-naya*), an RSIU-5V VHF radio, an updated ARK-54I ADF, an MRP-56P marker beacon receiver, an RV-U low-range radio altimeter, an SRO-2M IFF transponder and an SOD-57M decimetre-waveband ATC transponder. For high-altitude operations the pilot was provided with a KKO-3 oxygen system and a VKK-4 pressure suit with a GSh-4M pressure helmet. Larger mainwheels were fitted to enable operation from semi-prepared tactical airstrips (at least in theory).

The first prototype (Ye-7/1) entered flight test on 10th August 1959. Unfortunately the aircraft crashed on 26th November 1959 after losing control at maximum speed; this prompted a number of design changes aimed at enhancing directional stability at high Mach numbers (first and foremost, vertical tail area was increased and a KAP-1 autopilot serving the roll control channel only (hence the KAP for ***kren**ovyy avtopi**lot*** – bank [control] autopilot) was introduced.

On 30th May 1960 the Council of Ministers Presidium's Commission on defence industry matters (VPK – *Vo**yen**no-pro**mysh**lennaya ko**mis**siya*) ordered the Ye-7 into production at the Gor'kiy aircraft factory No.21 without waiting for the completion of the interceptor's state acceptance trials. However, the VPK ruling stated that it was not the MiG-21P but the improved MiG-21PF that was to enter production; it differed from the MiG-21P in having a 380-litre (83.6 Imp gal) increase in internal fuel capacity. The first production interceptors were to roll off the Gor'kiy production line as early as the first quarter of 1961.

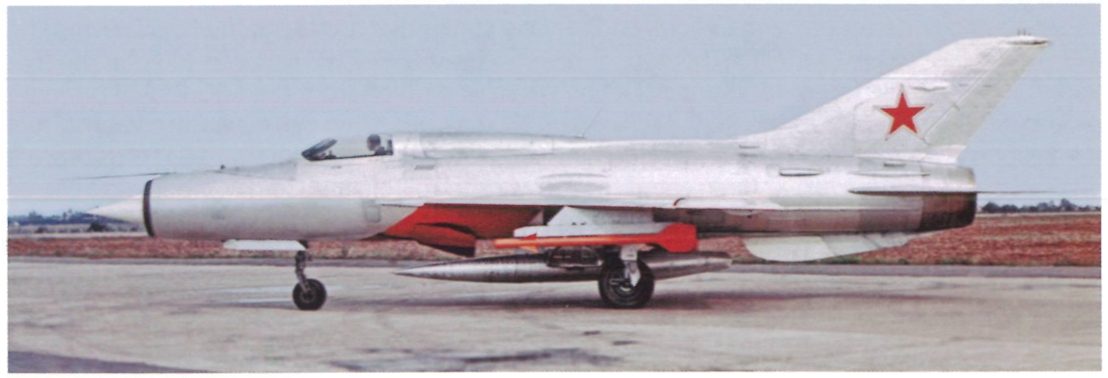
The fourth interceptor prototype (Ye-7/4) became the MiG-21PF prototype. It incorporated the following design changes. The fuel system was revised to incorporate a 170-litre (37.4 Imp gal) saddle tank immediately aft of the cockpit (with appropriate changes to the upper fuselage contour) and two additional 105-litre (23.1 Imp gal) integral tanks in the wings. Vertical tail area was increased again to enhance directional stability in spite of the higher all-up weight. A new KAP-2 autopilot was fitted. Finally, changes were made to the landing gear. The aircraft was powered by a Tumanskiy R11F2-300 afterburning turbojet.

The Ye-7/4 entered flight test on 8th August 1960. Upon completion of the manufacturer's tests the aircraft was transferred to GK NII VVS for state acceptance trials, together with the similarly converted Ye-7/3. The trials programme was completed on 30th June 1961, the State commission giving a positive appraisal to the interceptor. The interceptors attained a top speed of 2,175 km/h (1,351 mph), a service ceiling of 19,000 m (62,335 ft) and a range of 1,600-1,700 km (993-1,056 miles).

By the time the State commission recommended the interceptor for production and Soviet Air Force service, MiG-21PF production at the Gor'kiy factory No.21 with the product code *izdeliye* 76 had actually begun. The first production MiG-21PF took to the air at Gor'kiy-Sormovo (the factory airfield) on 28th June 1961.

The production model differed from the prototypes in several respects. Notably, from

A MiG-21PF wearing special colours for an air event, with two red-painted dummy K-13 AAMs and a PTB-490 drop tank.



the seventh production batch onwards the TsD-30T (aka RP-9-21) radar was replaced by the TsD-30TP exhibiting higher resistance to electronic countermeasures (ECM), hence the P suffix denoting *po**mekh**ozashchi**shchon**nost'* (ECM resistance); the TsD-30TP also had the minimum operational altitude reduced from 4,000 to 2,000 m (from 13,120 to 6,560 ft) and a larger radarscope. In production form the radar was designated RP-21. The production MiG-21PF had an internal fuel capacity of 2,750 litres (605 Imp gal). Additionally, a 490-litre (107.8 Imp gal) drop tank could be fitted to the centreline pylon.

The weapons control system (WCS) was revised, enabling the MiG-21PF to carry the RS-2-US semi-active radar-homing AAMs inherited from the MiG-19PM as a 'second choice'. To this end the first production MiG-21PF became a testbed for the K-51 weapons system. Renewed state acceptance trials took place between 20th November 1962 and 3rd

Another view of the same fighter showing the one-piece forward-hinged canopy.

September 1963 and the system received a thumbs-up. The integration of the RS-2-US expanded the MiG-21PF's operational envelope, enhancing its day/night IMC capability; it also permitted daylight/VMC (line-of-sight) launches with the radar operating in 'fixed beam' mode, using the PKI collimator sight.

The first all-weather version was produced in Gor'kiy for the 'home market' in 1962-68 (and in Moscow in 1964-68 for export only). The MiG-21PF was officially included into the inventory in early 1962, serving with the Air Force and the PVO alike. The NATO reporting name was *Fishbed-D*.

Mikoyan MiG-21PFS interceptor (Ye-7SPS, *izdeliye* 94; *Fishbed-D/ Fishbed-F*)

One of the Mikoyan OKB's efforts to improve the MiG-21 was directed at enhancing field performance. Accordingly a version of the MiG-21PF equipped with blown flaps was developed. The fighter was powered by an R11F2S-300 turbojet featuring air bleed valves to cater for the boundary layer control system (BLCS). The latter increased the flaps' efficiency, thereby affording a reduction in approach/landing speed. Thanks to the BLCS and the new brake parachute of greater area relocated to the base of the rudder the landing run was shortened to 480 m (1,575 ft). To shorten the take-off run the designers incorporated provisions for JATO boosters.

Once the prototype designated Ye-7SPS (*sdoov pogra**nich**novo **sloy**a* – BLC) had completed its test cycle in the first half of 1962, the BLC-equipped version of the interceptor entered production in Gor'kiy as the MiG-21PFS (*izdeliye* 94). Early examples retained the early-style vertical tail. However, from Batch 10 onwards a larger vertical tail was introduced, the NATO reporting name changing to *Fishbed-F*. Still later, the original SK ejection seat was replaced by the new KM-1 seat having an expanded operational envelope; hence the forward-hinged one-piece canopy gave way to a two-piece sideways-opening canopy.

Mikoyan MiG-21PFM interceptor (Ye-7SPS, Ye-7M, *izdeliye* 94; *Fishbed-F*)

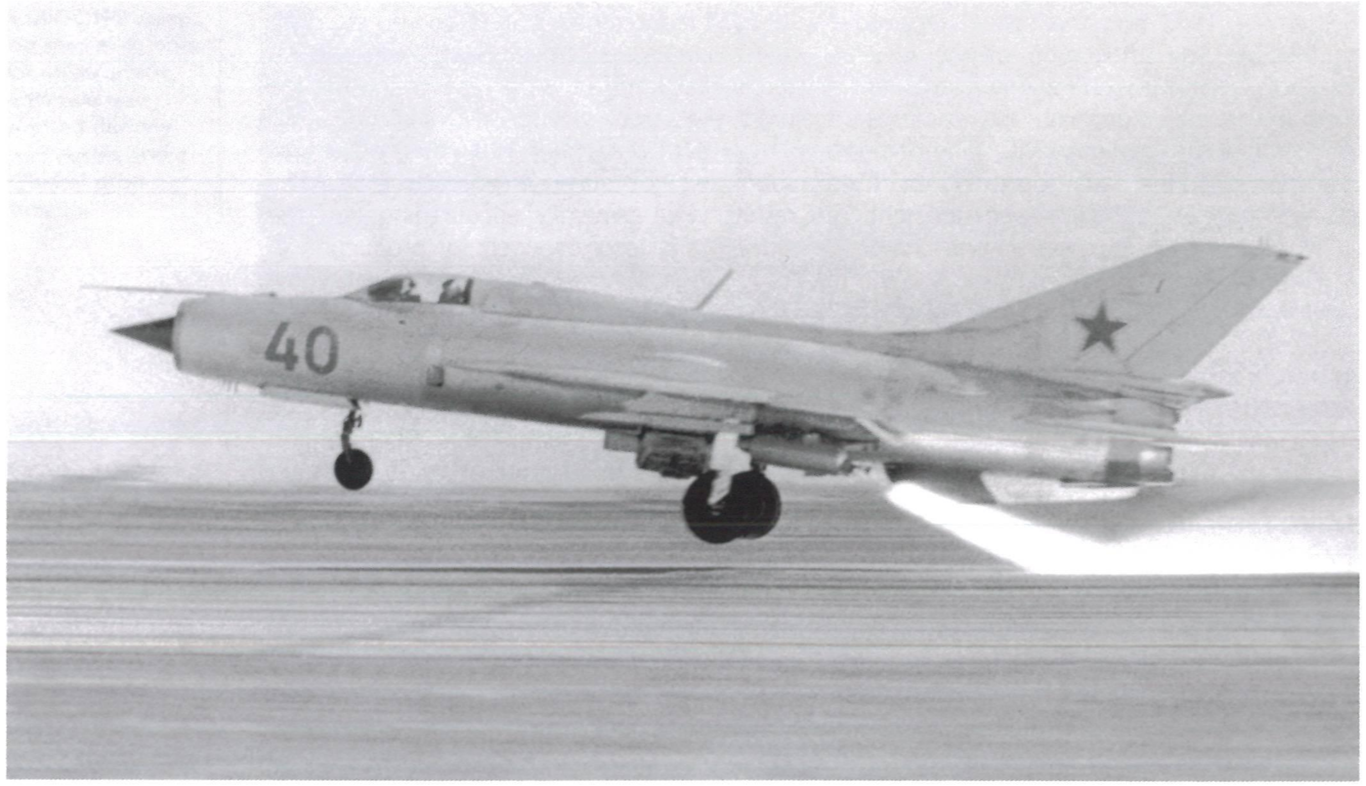
The Ye-7SPS was followed by the Ye-7M (*moderni**zee**rovannyy* – updated), which had an upgraded targeting system, including an RP-21M radar, a new ASP-PF computing sight and a *Samo**tsvet*** (gem) forward-looking infra-red seeker, and an ***Is**kra* (Spark) short-range radio navigation system.

On 27th December 1962 the Ye-7M was submitted for state acceptance trials. The results were generally encouraging and the aircraft was recommended for production in 1964. Thus, starting from Batch 20, the production MiG-21PFS interceptor received a systems upgrade and a new designation, MiG-21PFM. An important feature of the new model was the reinstatement of cannon armament. This time a detachable GP-9 cannon pod (*gon**dol**a **push**echnaya*) accommodating a 23-mm (.90 calibre) Gryazev/Shipunov GSh-23L twin-barrel cannon could be fitted on the centreline.

Interestingly, once the MiG-21PFM designation had been introduced, the Soviet Air Force started applying it retroactively to existing late-production MiG-21PFSs because the two versions were outwardly identical and had the same product code. The NATO saw no difference either, and the MiG-21PFM was codenamed *Fishbed-F*. Like their predecessors, the MiG-21PFS and MiG-21PFM saw service with Air Force and PVO fighter units alike.

Mikoyan MiG-21S tactical fighter (Ye-7S, *izdeliye* 95; *Fishbed-J*)

The MiG-21R *Fishbed-H* reconnaissance version introduced a larger saddle tank (internal fuel capacity was 2,800 litres/616 Imp gal) and extra 'wet' wing hardpoints for carrying drop tanks, giving it longer range without causing an unacceptable deterioration of other performance parameters. Therefore the designers chose to incorporate these features on the interceptor as well. The result was the Ye-7S of 1964, which entered production as the MiG-21S (*izdeliye* 95). It had a new Sapfeer-21 radar (Sapphire, aka S-21 or RP-22) working with an ASP-PF-21 computing sight. A new AP-155 autopilot providing autostabilisation in all three control channels and automatic recovery to straight and level flight from any attitude replaced the KAP-2 bank-only autopilot; an improved ARL-S Lazoor'-M GCI data link system was fitted. The R11F2S-300 engine, the BLCS system and the KM-1 ejection seat remained unchanged. The weapons range was expanded by adding R-3R (K-13R) missiles with SARH seeker heads. The MiG-21S interceptor had four wing pylons; thus, up to four AAMs could be carried.



MiG-21PFS '40 Blue' takes off with the help of SPRD-99 JATO boosters.

A MiG-21PFM shows off its larger vertical tail with a dielectric insert enclosing antennas.

The MiG-21S was in production at plant No.21 in 1965-68 and was delivered solely to the Soviet Air Force. However, this version was also used in the interests of the PVO. The maximum speed was 2,175 km/h (1,351 mph) and the service ceiling was 18,000 m (59,055 ft). The MiG-21S had the NATO reporting name *Fishbed-J*.

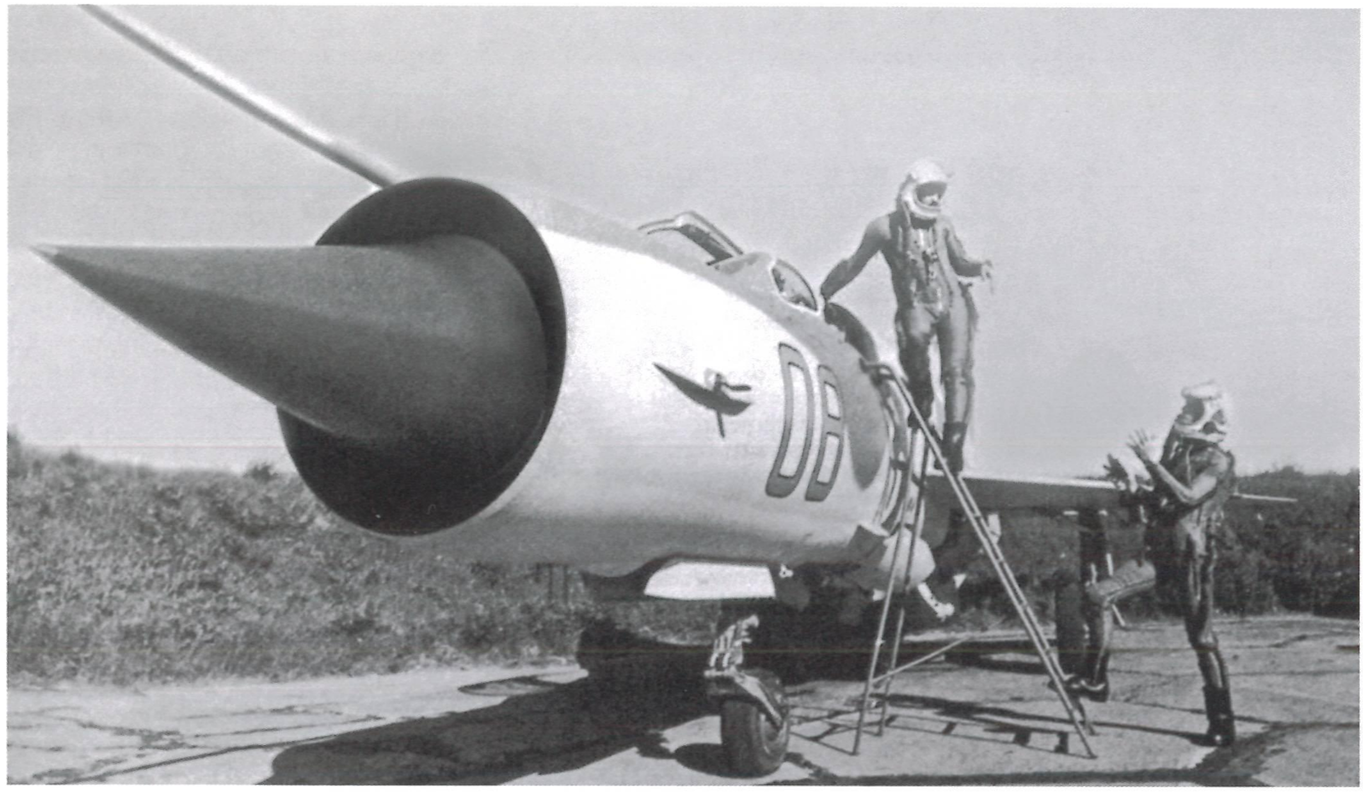
Mikoyan MiG-21SM tactical fighter (*izdeliye* 95M, *izdeliye* 15; *Fishbed-J*)

In 1969 the MiG-21S was superseded on the Gor'kiy production line by the MiG-21SM (*moderni**zee**rovannyy* – updated); the product code was initially *izdeliye* 95M but later changed to *izdeliye* 15). The fighter was powered by a new Tumanskiy R13-300 engine offering more thrust (6,490 kgp/14,310 lbst in full afterburner), 50% higher surge resistance and higher reliability. A built-in GSh-23L cannon (first used on the MiG-21M export version) was installed. Apart from the powerplant and the built-in cannon, the MiG-21SM had a considerably updated avionics suite and an expanded weapons range. The RP-22 (Sapfeer-21) radar worked in conjunction with an ASP-PFD optical sight, which was specially modified for close-in dogfighting. As in the case of the MiG-21M, the installation of the cannon and its ammunition box necessitated changes to the No.2 bladder tank; additionally, the aircraft was able to carry an 800-litre (176 Imp gal) centreline drop tank. The MiG-21SM's four wing hardpoints could carry various combinations of air-to-air and air-to-ground weapons.

The MiG-21SM became one of the Soviet Air Force's most widespread fighter types. Its NATO reporting name was likewise *Fishbed-J*.

Mikoyan MiG-21*bis* tactical fighter (Ye-7*bis*, *izdeliye* 75; *Fishbed-L/N*)

In the late 1960s, the performance of the MiG-21 could be further improved only by fitting a more powerful engine and a more capable radar. By 1971 Sergey K. Tumanskiy's OKB-300 had completed development of the R25-300 afterburning turbojet delivering 7,100 kgp (15,650 lbst) in full afterburner. Meanwhile, the Mikoyan OKB optimised the fuel system to provide the longest possible



'Valiant guardians of the Soviet skies' wearing VKK-3 suits and GSh-6 pressure helmets have a discussion beside a camouflaged MiG-21SM coded '08'.

Someone obviously forgot to remove the auxiliary intake covers from MiG-21SM '20 Blue' before this propaganda shot was taken. The underside of the nose is not painted white as implied by the photo – it is a just a trick of the light.

Two views of a MiG-21*bis* carrying a PTB-800 drop tank, two R-3S AAMs and four inert R-60 AAMs. Note the differing skin colours on the airframe.

range without unacceptably compromising other performance parameters and agility. The designers came up with a new saddle tank that was something in between the tanks of the MiG-21SM and the excessively heavy MiG-21SMT *Fishbed-K* (the latter's tank was the largest among MiG-21 versions). The internal fuel capacity was 2,880 litres (633.6 Imp gal). Another change was the addition of a booster pump serving the afterburner. The resulting aircraft was designated MiG-21*bis*.

The more powerful engine, together with the aerodynamically cleaner fuselage and optimum fuel load, produced a marked improvement in flight performance. Instead of two R-3S short-range AAMs the MiG-21*bis* carried

four R-60 'dogfight AAMs' on APU-60-2 paired launch rails on the outer wing pylons as standard. The weapons options also included the R-13M IR-homing AAM which had twice the launch range of the R-3S and was able to engage targets making high-G manoeuvres. The MiG-21*bis* had an improved Sapfeer-21M fire control radar, known as the RP-22M in production form. The ASP-PFD sight was modified, allowing certain restrictions on gunnery during high-G manoeuvres to be lifted.

The MiG-21*bis* entered flight test in 1971; production at the Gor'kiy factory commenced in 1972 and the fighter became operational that same year. The domestic variant supplied to the Soviet Air Force and the PVO was known as *izdeliye* 75. The Air Force and PVO versions differed in equipment fit; the air defence version was equipped with the ARL-S Lazoor'-M GCI guidance system. The remainder of the systems and equipment was virtually identical to those of the MiG-21SM. The PVO version of the MiG-21*bis* was codenamed *Fishbed-L*.

Mikoyan MiG-23M tactical fighter (*izdeliye* 23-11M, *izdeliye* 2M; *Flogger-B*)

Experience with the initial production MiG-23S *Flogger-A* 'swing-wing' fighter led to changes implemented on the '1971-model' MiG-23 (aka MiG-23 *sans suffixe*) and then on the MiG-23M (*modifi**tsee**rovannyy* – modified, known as *izdeliye* 23-11M and *izdeliye* 2M). Like the interim '1971 model', the MiG-23M had extended-chord swivelling outer wings creating a distinctive leading-edge dogtooth and the tail surfaces moved aft 0.86 m (2 ft 9$\frac{55}{64}$ in) compared with the MiG-23S. The major difference from the predecessor was the new Khachaturov R29-300 engine replacing

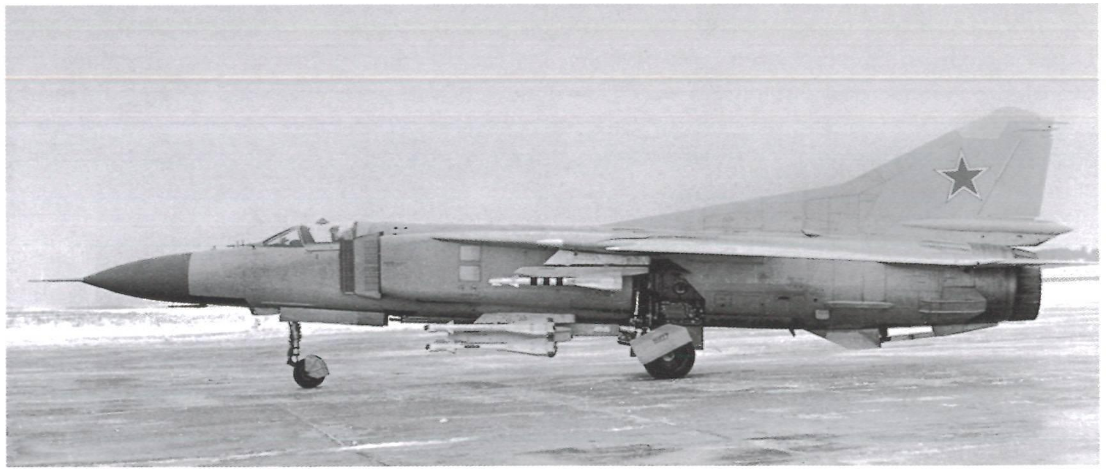
MiG-21 version specifications

	MiG-21PF	MiG-21PFM	MiG-21S	MiG-21SM	MiG-21*bis*	MiG-21UM
Year	1960	1963	1964	1967	1971	1971
Powerplant	R11F2-300	R11F2S-300	R11F2S-300	R13-300	R25-300	R11F2S-300
Thrust, kgp (lbst):						
dry	3,950 (8,710)	3,950 (8,710)	3,950 (8,710)	4,070 (8,970)	4,100 (9,040)	3,950 (8,710)
reheat	6,120 (13,490)	6,175 (13,610)	6,175 (13,610)	6,490 (14,310)	7,100 (15,650)	6,175 (13,610)
Length overall:						
including pitot	14.5 m (47 ft 6$\frac{55}{64}$ in)	14.5 m (47 ft 6$\frac{55}{64}$ in)	15.0 m (49 ft 2$\frac{33}{64}$ in)	15.0 m (49 ft 2$\frac{33}{64}$ in)	15.0 m (49 ft 2$\frac{33}{64}$ in)	15.76 m (51 ft 8$\frac{15}{32}$ in)
less pitot	14.1 m (46 ft 3$\frac{1}{8}$ in)	14.1 m (46 ft 3$\frac{1}{8}$ in)	14.1 m (46 ft 3$\frac{1}{8}$ in)	14.1 m (46 ft 3$\frac{1}{8}$ in)	14.1 m (46 ft 3$\frac{1}{8}$ in)	13.46 m (44 ft 1$\frac{59}{64}$ in)
Wing span	7.154 m (23 ft 5$\frac{21}{32}$ in)	7.154 m (23 ft 5$\frac{21}{32}$ in)	7.154 m (23 ft 5$\frac{21}{32}$ in)	7.154 m (23 ft 5$\frac{21}{32}$ in)	7.154 m (23 ft 5$\frac{21}{32}$ in)	7.154 m (23 ft 5$\frac{21}{32}$ in)
Height on ground	4.125 m (13 ft 6$\frac{13}{32}$ in)	4.125 m (13 ft 6$\frac{13}{32}$ in)	4.125 m (13 ft 6$\frac{13}{32}$ in)	n.a.	n.a.	n.a.
Wing area, m^2 (sq ft)	23.0 (247.3)	23.0 (247.3)	23.0 (247.3)	23.0 (247.3)	23.0 (247.3)	23.0 (247.3)
Empty weight, kg (lb)	n.a.	n.a.	n.a.	n.a.	5,339 (11,770)	n.a.
Normal take-off weight, kg (lb)	7,750 (17,085)	7,800 (17,195)	8,150 (17,970)	8,300 (18,300)	8,725 (19,235)	8,000 (17,640)
Maximum speed at altitude, km/h (mph)	2,175 (1,350)	2,230 (1,385)	2,230 (1,385)	2,230 (1,385)	2,175 (1,350)	2,175 (1,350)
Time to height, minutes (m/ft)	6.2/10,000 (32,810)	8.0/18,500 (60,695)	8.5/17,500 (57,410)	9.0/17,500 (57,410)	8.5/17,000 (55,770)	8.0/16,800 (55,120)
Service ceiling, m (ft)	19,000 (62,335)	19,000 (62,335)	18,000 (59,055)	18,000 (59,055)	17,800 (58,400)	17,300 (56,760)
Range, km (miles)	1,900 (1,180)	1,670 (1,037)	1,240 (770) [1]	1,050 (652) [1]	1,210 (751) [1]	1,460 (906)
Take-off run, m (ft)	900 (2,950)	950 (3,120)	900 (2,950)	800 (2,620)	830 (2,720)	900 (2,950)
Landing run, m (ft)	850 (2,790)	950 (3,120)	550 (1,800)	550 (1,800)	550 (1,800)	550 (1,800)
Armament:						
cannons	–	1 x GSh-23 [2]	1 x GSh-23 [2]	1 x GSh-23L	1 x GSh-23L	1 x A-12.7 [3]
missiles	2 x R-3S	2 x R-3S	2-4 x R-3S	2 x R-3S 2 x R-3R	2 x R-3R 4 x R-60	2 x R-3S

Notes:

1. On internal fuel 2. In GP-9 pod (late batches only) 3. Machine-gun

A MiG-23M with the wings at maximum sweep. Note the gap in the fixed upper portion of the ventral fin caused by the fact that the folding portion has a counterweight at the top which finds itself on the port side when the fin folds to starboard.



Another view of the same aircraft. The aircraft is armed with six R-60 AAMs – two on APU-60 launch rails under the wing gloves and four on APU-60-2 double launchers on the fuselage hardpoints.

the earlier R27-300. It was rated at initially 12,200 kgp (26,900 lbst) and later 12,500 kgp (27,560 lbst) in full afterburner; at the time it was the world's most powerful fighter engine.

Other important changes were a new WCS which included a Sapfeer-23D-III fire control radar, a TP-23 FLIR sensor and an ASP-23D sight. For the first time a Soviet fighter had a radar capable of distinguishing most targets against ground clutter. Additionally, it enjoyed a detection range of 55 km (34.2 miles) and a tracking range of 35 km (21.7 miles).

The MiG-23ML was characterised by the almost non-existent dorsal fin extension. Here, R-24 medium-range AAMs are carried on the wing glove pylons.

The MiG-23M first flew in June 1972, piloted by Aleksandr V. Fedotov. Prototypes and early production aircraft had so-called Type 2 outer wings with a dogtooth but no leading-edge devices. However, they made the fighter prone to sudden stalls in take-off and landing modes, which was unsafe, and were quickly replaced by Type 3 wings featuring both a dogtooth and leading-edge flaps. The wing carry-through box was reinforced at the same time, allowing the fighter to pull 8 Gs (versus only 5.55 Gs for the MiG-23S) during combat manoeuvres at speeds below Mach 0.85 with the wings set at 45°.

Improved flight control was achieved with the SAU-23A autopilot. Tactical navigation was managed by the Polyot-1I-23 system, which included the RSBN-6S SHORAN, the ARK-15 ADF, the RV-4 radio altimeter and the Lazoor'-SM command data link system.

From Batch 37 onwards the MiG-23M could fire the Vympel R-23R and R-23T (SARH or IR-homing respectively) medium-range AAMs. Earlier aircraft, where appropriate, were brought up to this standard. Two R-23s plus two (or, from Batch 32 onwards, four) R-60 short-range missiles could be carried. Also, a built-in GSh-23L cannon with an ammunition supply of 200 rounds was provided.

Production took place at MMZ No.30 in Moscow in 1972-78. Codenamed *Flogger-B* by NATO, the MiG-23M became one of the PVO's principal fighter types.

Mikoyan MiG-23ML tactical fighter (*izdeliye* 23-12, *izdeliye* 3; *Flogger-G*)

The MiG-23ML version (*modifi**tsee**rovannyy,* ***lyoh**kiy* – modified, lightweight) was specifically designed as an air superiority fighter with only a secondary ground attack capability. The Mikoyan OKB took pains to produce a much lighter structure without sacrificing the ability to perform high-G manoeuvres. The empty weight of the MiG-23ML was 10,230 kg (22,560 lb) – 660 kg (1,455 lb) less than the MiG-23M's, and the structure was restressed for 8.5 Gs. The fuselage was slightly shorter and the large dorsal fin of previous versions was almost eliminated, with only a slight kink on the fin leading edge. The wing trailing edge flaps were redesigned as well.

Once again, the MiG-23ML featured a new powerplant – the Khachaturov R35-300. A derivative of the R29-300 with a higher turbine temperature, it was lighter and more powerful, delivering 8,550 kgp (18,850 lbst) dry and 13,000 kgp (28,665 lbst) reheat. It also had a lower specific fuel consumption. The No.4 fuel tank was deleted; this did not entail any significant loss of range thanks to the more streamlined airframe and the more fuel-efficient engine.

Further improvements included an upgraded SAU-23AM flight control system and avionics. A new S-23ML fire control system built around the lighter Sapfeer-23ML radar was introduced for use exclusively against aerial targets. As with the MiG-23M, there were two pylons under the air intakes and two under the wing gloves; these could carry new semi-active radar-homing R-24R and IR-homing R-24T AAMs. The wing glove pylons could now carry UPK-23-250 gun pods (*ooniver**sahl'**nyy **push**echnyy kon**tey**ner* – versatile gun pod), each holding a GSh-23L cannon with 250 rounds. If carried, they made a formidable addition to the internal GSh-23L cannon.

The prototype MiG-23ML first flew on 21st January 1975 with Aviard G. Fastovets at the controls. Series production took place at the Moscow Aircraft Production Association (MAPO) between 1976 and 1983; the type was delivered to the PVO because the specialised MiG-23P (see below) was not available in sufficient numbers. Most MiG-23MLs in Soviet service were converted to MiG-23MLD *Flogger-K* standard in the 1980s.

Mikoyan MiG-23P interceptor (*izdeliye* 23-14, *izdeliye* 6; *Flogger-G*)

The MiG-23P (*pere**khvat**chik* – interceptor) was a derivative of the MiG-23ML produced for the PVO. In spite of its reputation as a dedicated interceptor, it retained ground attack capability and pilots were trained to fire Kh-23 air-to-surface missiles until 1989 when this practice was officially discontinued.

For its interceptor role, the MiG-23P received a new S-23MLA weapons system including a more advanced N006 *Ame**tist*** (Amethyst) radar (some documents call it Sapfeer-23P), a TP-23M FLIR and a new S-17MLP gunsight. An upgraded R-862 radio and the new SAU-23PM autopilot were also installed. With the advent of the MiG-31 heavy interceptor with its larger radar and the Il'yushin/Beriyev A-50 AWACS aircraft, the automated ground control system vectoring interceptors automatically to their target was extended to incorporate these aircraft as airborne command posts. Pilots even received

Specifications of MiG-23 variants operated by the PVO

	MiG-23M	MiG-23ML	MiG-23P	MiG-23UB
Wing span:				
at 16° sweep	13.965 m (45 ft 9 51/64 in)	13.965 m (45 ft 9 51/64 in)	13.965 m (45 ft 9 51/64 in)	13.965 m (45 ft 9 51/64 in)
at 72° sweep	7.779 m (25 ft 6 17/64 in)	7.779 m (25 ft 6 17/64 in)	7.779 m (25 ft 6 17/64 in)	7.779 m (25 ft 6 17/64 in)
Length, including pitot	16.71 m (54 ft 9 7/8 in)	16.71 m (54 ft 9 7/8 in)	16.71 m (54 ft 9 7/8 in)	16.42 m (53 ft 10 29/64 in)
Wing area, m² (sq ft):				
at 16° sweep	37.27 (401.03)	37.27 (401.03)	37.27 (401.03)	37.27 (401.03)
at 72° sweep	34.16 (367.57)	34.16 (367.57)	34.16 (367.57)	34.16 (367.57)
Weight empty, kg (lb)	10,890 (23,020)	10,230 (22,560)	10,215 (22,520)	10,920 (24,080)
Internal fuel load, kg (lb)	4,090 (9,020)	3,700 (8,160)	3,700 (8,160)	3,520 (7,760)
Normal take-off weight, kg (lb)	15,700 (34,620)	14,770 (32,570)	14,770 (32,570)	15,080 (33,250)
Maximum take-off weight, kg (lb)	18,400 (40,570)	17,800 (39,250)	17,800 (39,250)	18,000 (39,690)
Maximum warload, kg (lb)	2,000 (4,410)	2,000 (4,410)	2,000 (4,410)	1,600 (3,530)
Wing loading at normal TOW (72° wing sweep), kg/m² (lb/sq ft)	460 (94.2)	432 (88.6)	432 (88.6)	441 (90.5)
Maximum indicated airspeed (in 'clean' condition), km/h (mph):				
at sea level	1,350 (839)	1,400 (870)	1,350 (839)	1,350 (839)
at 12,500 m (41,000 ft)	2,500 (1,554) (Mach 2.35)	2,500 (1,554) (Mach 2.35)	2,500 (1,554) (Mach 2.35)	2,500 (1,554) (Mach 2.35)
Service ceiling (clean), m (ft)	17,500 (57,420)	18,600 (61,030)	18,500 (60,700)	15,800 (51,840)
Rate of climb, m/sec (ft/min)	195 (38,376)	215 (42,312)	215 (42,312)	145 (28,536)
Ferry range, km (miles):				
'clean'	1,450 (901)	1,450 (901)	1,900 (1,181)	1,210 (752)
with three 800-litre drop tanks	2,380 (1,479)	2,360 (1,467)	2,820 (1,752)	1,550 (963)
Maximum combat load factor:				
up to Mach 0.85	8.0	8.5	7.5	7.0 G
above Mach 0.85	7.0	7.0	7.0	
Unstick speed, km/h (mph)	262 (181)	280 (174)	280 (174)	290 (180)
Landing speed, km/h (mph)	235 (146)	245 (152)	245 (152)	260 (162)
Take-off run, m (ft)	800 (2,625)	450 (1,480)	450 (1,480)	650 (2,130)
Landing run, m (ft)	825 (2,710)	750 (2,460)	650 (2,130)	850 (2,790)

signals when to activate a missile or engage the afterburner during an attack.

The MiG-23P was built by MAPO from 1978 to 1983; the type remained in service right through to 1998. Many MiG-23Ps were likewise converted to MiG-23MLD standard.

Mikoyan MiG-23UB combat trainer (*izdeliye* 2U, *Flogger-C*)

A dual-control version that preceded the MiG-23M was used by the PVO for conversion and proficiency training. Designated MiG-23UB (*oo**cheb**no-boye**voy*** [*samo**lyot***] – combat trainer) and known as *izdeliye* 2U, it combined the MiG-23M's Type 3 wings and position of the tail surfaces with vertically staggered tandem seating for the trainee and instructor, who sat under a common canopy with individual hinged portions. The aircraft was powered by the Tumanskiy R27F2M-300 afterburning turbojet and shared the S-21 WCS of the initial production MiG-23U. The MiG-23UB was equipped with an R-832M radio and an R-855UM emergency radio, an ARK-10 (later ARK-15DM) ADF, an MRP-56P marker beacon receiver, an S-3M passive radar warning system and a *Reper-M* (Benchmark) active radar jammer.

The first flight took place on 10th April 1970 with Mikhail M. Komarov at the controls. In 1972 the MiG-23UB replaced the MiG-23U on the production line at the Irkutsk aircraft factory No.39; production continued until 1978. Since MiG-23UBs delivered to the VVS and the PVO alike had no fire control radar (instead, ballast was installed in the nose to maintain the CG position), the customary armament comprised R-3S heat-seeking AAMs and the built-in GSh-23L cannon with an ammo supply of 200 rounds. An ASP-PFD-21 gunsight without radar ranging was fitted in the front cockpit for use with the cannon. The NATO reporting name was *Flogger-C*.

Mikoyan MiG-25P interceptor (*izdeliye* 84, *Foxbat-A*)

First flown in Ye-155P prototype form on 9th September 1964, the MiG-25P interceptor entered initial production in 1969; the in-house product code at the Gor'kiy plant was *izdeliye* 84. The first production MiG-25Ps were almost identical to the prototypes, featuring small vertical tails, large ventral fins and endplate fins at the wingtips. In this form the *Foxbat-A* achieved initial operational capability in April 1969 with the PVO's 148th TsBP i PLS and one of the first-line PVO fighter regiments based in Pravdinsk near Gor'kiy. Full-scale production began in 1971; the basic production version differed in having enlarged and recontoured fins, smaller ventral fins and wings with 5° anhedral and no endplates.

The MiG-25P's WCS was built around the RP-25 Smerch-A1 (Tornado) radar and the K-10T sight. The armament consisted of four R-40 AAMs – two R-40R missiles with SARH seeker heads and two R-40T IR-homing missiles. The MiG-25P featured the Lazoor' data link system and the Polyot-1I flight control system which automated flying a great deal. The Lazoor' system was linked with the weapons control system, enabling the aircraft to be directed to the target area automatically or semi-automatically. The flight control system provided automatic climb and acceleration to a preset speed and autostabilisation in all three channels, maintained a constant speed and altitude, and limited G loads and alpha.

Apart from the radar and sight, the avionics suite included an IFF set (an SRO-2M transmitter and an SRZM-2 receiver), a Sirena-3 RWR, an RV-UM (RV-4) low-range radio altimeter, an ARK-10 ADF, an MRP-56P marker beacon receiver, an SP-50 ILS, an RSBN-6S SHORAN set, R-832M and Prizma radios and the SAU-155P1 automatic control system.

The MiG-25P remained in production until 1982, by which time just over 460 had been manufactured. On 13th April 1972 the Council of Ministers issued a directive officially clearing the MiG-25P for service. By the mid-1970s the type was an important part of the PVO's interceptor inventory.

As the aircraft entered service the designers set to work refining it. A new Vozdukh-1M GCI system entered service, expanding the interceptor's tactical capabilities. In the mid-1970s the MiG-25P received an upgraded Smerch-A2 radar offering higher reliability, as well as upgraded data link and AFCS and improved communications equipment. Later this radar was supplanted by the Smerch-A3 featuring a spatial selection mode that gave the interceptor 'look-down/shoot-down' capability; yet this method was deemed insufficiently effective and the Smerch-A3 gave way to a different radar, the S-25. A further refined version, the Smerch-A4, was under development; by then, however, fire control radars had to be capable of picking out targets among ground clutter, which a monopulse low-PRF radar was incapable of doing.

Opposite page: The MiG-25P was equipped with the RP-25 Smerch radar and armed with a quartet of R-40 medium-range AAMs.

This view of a MiG-25PD flying above heavy overcast shows well the aircraft's layout with wings located well aft and massive 2-D air intakes flanking the forward fuselage.

Mikoyan MiG-25PD interceptor (*izdeliye* 84D, *Foxbat-A*)

Lt. Viktor Belenko's notorious defection to Japan in a MiG-25P in September 1976 allowed the Americans to study the aircraft in detail, compromising the type's combat efficiency. As a remedy, it was decided to develop urgently a new WCS for new-build MiG-25s and retrofit it to existing ones; an appropriate Council of Ministers directive appeared on 4th November 1976. The new aerial intercept weapons system was designated MiG-25-40D and based on the MiG-25PD aircraft (D stood for *dora**bot**annyy* – modified or upgraded). It was required to intercept aerial targets within a wider speed/altitude envelope and at longer range.

The upgrade was developed in a remarkably short time. The Smerch-A radar gave place to a Sapfeer-25 (S-25, or N005) quasi-continuous emission radar (a derivative of the MiG-23's recently debugged Sapfeer-23). This had longer detection range – for a bomber-type target, it was up to 80 km (49.6 miles) in pursuit mode and 115 km (71.42 miles) in head-on mode – and a lock-on range of up to 60 km (37.2 miles) and 80 km (49.6 miles) respectively. It was also better at picking out targets against ground clutter and gave the aircraft 'look-down/shoot-down' capability, with a detection range of 25/30 km (15.5/18.6 miles) in pursuit/head-on mode for a bomber-type target and 6/11 km (3.72/6.83 miles) for a cruise missile.

An *izdeliye* 26Sh-1 infrared search & track (IRST) system coupled with the radar was added to enhance ECM resistance and enable stealthy attacks without switching on the radar. An all-new Looch-1 (Ray) GCI system including more modern BAN-75 command link equipment (*bortovaya apparatoora navedeniya* – on-board guidance equipment) replaced the Vozdukh-1M. Likewise, a new IFF system was fitted. Since the electric system had been revised to cater for the new avionics, the MiG-25PD was powered by R15BD-300 engines; this version had the same rating as the R15B-300 but featured a modified accessory gearbox to take a new AC generator.

The R-40R and R-40T missiles were also modified to permit integration with the new radar, becoming the R-40RD and R-40TD respectively; once again the D stood for *dora**bot**annyy*. The two R-40TD missiles could be replaced by a quartet of R-60 or R-60M short-range IR-homing AAMs.

The first prototype MiG-25PD made its maiden flight on 19th November 1977 with Valeriy Ye. Menitskiy at the controls. Stage A of the state acceptance trials was completed in 1978. Stage B lasted from September 1978 to February 1979. Even as the test programme went ahead, in 1978 the Gor'kiy aircraft factory launched production of the MiG-25PD; production continued into 1984, a total of 104 examples being manufactured.

Mikoyan MiG-25PDS mid-life update (*izdeliye* 84DS, *Foxbat-A*)

Due to the MiG-25PD's substantially higher capabilities a decision was taken to upgrade all early production MiG-25Ps to the new standard. The mid-life update (MLU) programme began in 1979 and was undertaken by the Gor'kiy aircraft factory; the upgraded aircraft were redesignated MiG-25PDS (for *pere**khvat**chik, dora**bot**annyy v stro**yoo*** – field-modified interceptor, or interceptor updated in service). The only major difference from the new-build MiG-25PD was that the MiG-25PDS had no provisions for carrying the huge centreline drop tank.

The MLU programme was completed in 1982, just as MiG-25PD production ended. Thus, the capabilities of the PVO's MiG-25 fleet were not only retained but enhanced.

Mikoyan MiG-31 long-range interceptor (*izdeliye* 01, *Foxhound-A*)

In 1972 the Mikoyan OKB began development of the MiG-25MP (Ye-155MP) interceptor. The aircraft was powered by two Solov'yov D-30F afterburning turbofans and featured an all-new *Za**slon*** (Shield, or Barrier) WCS built around the N007 phased-array fire control radar which was to outperform any existing radar. The aircraft had a crew of two (pilot and weapons systems operator/navigator). The principal armament consisted of four K-33 long-range SARH missiles.

The MiG-25MP made its first flight on 16th September 1975 with Mikoyan OKB chief test pilot Aleksandr V. Fedotov at the controls. The aircraft was clearly superior to all interceptors then in PVO service as far as range, armament and the capabilities of the avionics suite were concerned. Therefore, as early as 1974 (before the aircraft had even flown!) a decision was taken to launch full-scale production of the new interceptor at factory No.21 in Gor'kiy under the service designation MiG-31.

After a number of design changes, the first production MiG-31s rolled off the assembly line in 1977. Stage A of the state acceptance trials began in May 1977 and was completed in December 1978 and GNIKI VVS issued a document clearing the type for full-scale production, which got under way in 1979 (the product code was *izdeliye* 01). That year the intended K-36DM ejection seats were introduced on the MiG-31.

Stage B of the state acceptance trials began in the spring of 1979, involving the testing of the weapons system as a whole (primarily the weapons control system and the armament as such). It was the Zaslon WCS in general and the radar in particular that required the greatest effort to debug.

In October 1978 a US surveillance satellite recorded the successful destruction of a low-flying target drone by the new Soviet interceptor. This fact was dragged into public view, and the Pentagon's press secretary Thomas Ross, who had stated just a month earlier that *'there is no evidence that the Soviets are capable of shooting down cruise missiles or target drones simulating such missiles'*, had to eat his words.

The trials of the MiG-31 interceptor, the Zaslon WCS and the K-33 AAM (known as the R-33 in production form) were duly completed in December 1980. On 6th May 1981 the Council of Ministers issued a directive clearing the new aerial intercept weapons system for service. In early 1980 the MiG-31s achieved initial operational capability. Full-scale deliveries began in 1982.

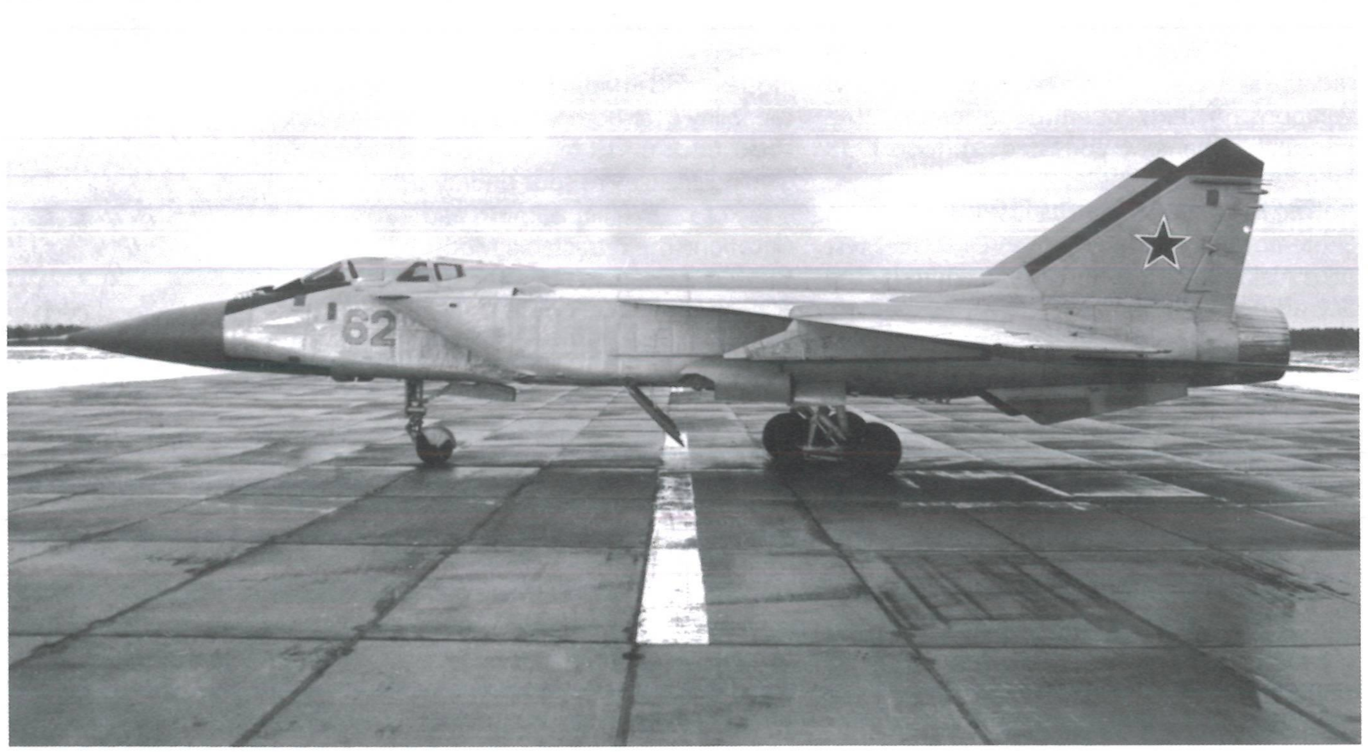
The aircraft's capabilities as an interceptor were truly unique. The MiG-31 was the world's first production interceptor to have a phased-array radar. The latter was capable of detecting targets in any weather, at altitudes between 50 and 28,000 m (165-91,860 ft); it enabled engagements in head-on and pursuit modes and had 'look-down/shoot-down' capability over both land and water. The radar could track up to ten targets at a time while guiding missiles to four priority threats within a sector of ±70° in azimuth and +70°/–60° in elevation. The retractable Model 8TP IRST unit allowed targets to be tracked covertly and IR-homing missiles to be used. Tactical situation displays in both cockpits gave the crew situational awareness. Special electronic support measures (ESM) equipment protected the interceptor from enemy ECM.

The principal armament comprised four R-33 long-range AAMs with inertial initial guidance, mid-course correction and active radar homing at the terminal guidance phase. This guidance algorithm was a 'world first'. The missiles were carried semi-recessed in the fuselage. Other weapons options included three R-33s plus two R-40TD medium-range IR-homing AAMs under the wings, or four

Two views of a typical production MiG-31 with no IFR probe coded '62 Blue'. The stowed IRST sensor and the associated anti-glare panel are visible below the front cockpit.

R-33s plus four R-60M short-range IR-homing AAMs on paired underwing launch rails. In the unlikely event of close encounters with the enemy the MiG-31 was armed with a 23-mm (.90 calibre) Gryazev/Shipunov GSh-6-23 six-barrelled Gatling cannon installed in a fairing above the starboard mainwheel well. The rate of fire was 8,000 rpm and the ammunition supply was 260 rounds.

Mission success was ensured by a unique weapons control system. The MiG-31's avionics suite allowed it to act as an airborne command post or 'mini-AWACS' if need arose. A flight of four MiG-31s, with the flight leader acting as an airborne command post, could swap information on targets detected within a swath up to 800 km (496 miles) wide. The aircraft could distribute multiple targets between



Front view of a MiG-31 (*izdeliye* 01DZ) with the refuelling probe deployed.

them or pass target information to the leaders of other interceptor flights; all data exchange proceeded in automatic mode, using secure channels. Three MiG-31s loitering in a designated area could provide full-time 360° coverage. The aircraft was capable of guiding up to three MiG-23P, MiG-25PD, MiG-29 or Su-27 fighters to their targets without revealing their presence by switching on the radars.

The variety of tasks performed by the MiG-31 was made possible in no small degree by the crew of two. The main reason for adding a navigator/WSO was the need to use the complex WCS efficiently. The pilot (captain) was the decision maker, while the WSO made all necessary preparations for engaging the target. He plotted the aircraft's course, processed target information, moni-

Another view of the same aircraft.

This MiG-31 coded '10 Red', represents the *izdeliye* 01DZ version. The retracted IFR probe is visible on the port side of the nose ahead of the windshield. Note the Mikoyan OKB badge on the air intake, despite the fact the at the aircraft did not belong to the Mikoyan OKB.

tored the tactical situation and selected the targets in priority order. Using the telescopic control stick and rudder pedals, he could fly the aircraft in case of need, which eased the psychological strain on the pilot during long missions.

For the first time in the Soviet Union, semi-autonomous action by groups of aircraft was made possible, given continuous information or just single notification about the target. This made it possible to use the new aerial intercept weapons system for closing the gaps in AD radar coverage in such areas as the Soviet High North. PVO fighter regiments flying the type received the capability to perform concerted action thanks to the MiG-31's automated tactical data exchange system; the maximum interception range was as long as 720 km (447 miles) from the base.

The break-up of the Soviet Union and the ensuing political and economic turmoil caused MiG-31 production to be discontinued because the Russian Ministry of Defence had no funds to order more. The production run totalled 505 aircraft, more than 300 of which remained on strength with the Russian Air Force at the turn of the century.

Mikoyan MiG-31 long-range interceptor with IFR capability (*izdeliye* 01DZ; *Foxhound-A*)

One of the MiG-31's deficiencies revealed in service was its inadequate range. Production *Foxhounds* based in Monchegorsk on the Kola Peninsula had to shadow Western reconnaissance and ASW aircraft at up to 720 km from their home base, but the PVO wanted more. This wish materialised as a version of the MiG-31 featuring the probe-and-drogue in-flight refuelling (IFR) system.

The retractable L-shaped refuelling probe was located ahead of the cockpit windshield, offset to port. The IFR system underwent lengthy trials on several aircraft, including three MiG-31s. Lengthy missions involving IFR necessitated the provision of a long-range radio navigation (LORAN) system. The duration of the flight with IFR was limited only by the crew's physiological limitations.

The new version entered production in 1990, staying in production for a year until it was succeeded by the more refined MiG-31B; the production run was small (about 45 aircraft). At the Gor'kiy aircraft factory the new version of the MiG-31 received the product code *izdeliye* 01DZ (the suffix denoted ***doza**-**prahv**ka* – refuelling); strangely enough, the addition of IFR capability affected neither the service designation nor the NATO reporting name in any way. Outwardly *izdeliye* 01DZ differed from the initial production version only in having a refuelling probe on the port side, which was quite unobtrusive when retracted.

Mikoyan MiG-31B long-range interceptor (*izdeliye* 01B, *izdeliye* 12; *Foxhound-A*)

Apart from extending the MiG-31's range, the Mikoyan OKB and its partners consistently worked on improving the interceptor's armament. The need to do so was due in no small degree to leaks of sensitive information about the MiG-31 to the West in the 1980s.

The work went ahead in two directions. Firstly, the OKB and its subcontractors were working on the radically improved MiG-31M *Foxhound-B* featuring an all-new weapons system; however, this aircraft would take a lot of time to test and perfect, to say nothing of series production. Hence the designers attempted to boost the combat potential of the basic model. Additionally, a long list of recommendations resulted from the MiG-31's state acceptance trials. These recommendations were combined with a number of new features developed by the OKB and the factory in the 1980s to form an upgrade package turning the MiG-31 *sans suffixe* into a new version designated MiG-31B.

The principal changes introduced on the MiG-31B were as follows:

- the upgraded RP-31A Zaslon-A WCS;
- the use of improved R-33S long-range AAMs featuring a longer 'kill' range;

This view shows how the forward pair of R-33 AAMs is semi-recessed in the MiG-31's belly.

A MiG-31B with no weapons on the eight hardpoints.

Basic specifications of the MiG-25PD and MiG-31		
	MiG-25PD	MiG-31
Length excluding nose probe	19.75 m (64 ft 9½ in)	22.668 m (74 ft 5 in) [1]
Wing span	14.015 m (45 ft 11 in)	13.456 m (44 ft 2½ in) [2]
Height on ground	6.5 m (21 ft 4 in)	5.15 m (16 ft 10½ in)
Wing area, including centre section, m² (sq ft):	61.4 (660.66)	61.6 (663.06)
Take-off weight, kg (lb):		
normal	34,920 (76,980)	37,100/41,000 (81,790/90,390) [3]
maximum	36,720 (79,960) [6]	45,900-46,200 (101,190-101,850)
Maximum speed, km/h (mph):		
at sea level	1,200 (750)	1,500 (932)
at 13,000 m (42,650 ft)	3,000 (1,863)	3,000 (1,864) [4]
Maximum Mach number	n.a.	2.83/2.35 6
Unstick speed, km/h (mph):	360 (225)	345/365 (214/226) [5]
Landing speed, km/h (mph):	290 (181)	280-285 (173-177)
Climb to 20,000 m (65,620 ft), min:	8.9	7.9
Service ceiling, m (ft):	20,700 (67,910) [6]	20,600 (67,585)
Range, km (miles):		
above Mach 1.0	1,250 (781) [6]	1,400 (869)
below Mach 1.0	1,730 (1,081) [6]	2,150-2,400 (1,335-1,491) [7] 2,850-3,000 (1,770-1,864) [7]
Intercept range, km (miles):		
supersonic	n.a.	720 (447)
subsonic, no drop tanks	n.a.	1,200 (745)
with drop tanks	n.a.	1,400 (870)
with drop tanks and one refuelling	n.a.	2,000 (1,242)
Endurance:		
on internal fuel	n.a.	3.6 hours
with one refuelling	–	6-7 hours
Take-off run, m (ft):	1,200 (3,940)	950 (3,120)
Landing run, m (ft):	800 (2,620)	800-900 (2,620-2,950)
G limit:	4.5	5.0
Armament:		
cannon	–	1 x GSh-6-23 w. 260 rounds
missiles	2 x R-40RD/2 x R-40TD or 1 x R-40RD/1 x R-40TD + 2-4 x R-60M	4 x R-33 or 3 x R-33 + 2 x R-40TD or 4 x R-33 + 2-4 x R-60M

Notes:
1. Including nose probe
2. Some manuals state 13.464 m (44 ft 2 5/64 in)
3. With four R-33s and normal fuel/maximum fuel, no drop tanks
4. At 17,000 m (55,770 ft) and above
5. Normal/maximum TOW
6. With R-40 missiles
7. At Mach 0.8 without/with drop tanks

• the use of alternative additional weapons (IR-homing missiles) carried on wing pylons – either two R-40T/R-40TD medium-range AAMs or four R-60M short-range AAMs on paired rails;

• the addition of an IFR system as used on the MiG-31/*izdeliye* 01DZ;

• the provision of new tactical information and weapons control modes ('downloading' target information to ground command posts or other aircraft – not necessarily sister ships, 'tandem guidance' in which another aircraft's fire control radar is used for guiding the interceptor's missile and the like);

• an upgraded navigation computer compatible with LORAN and satellite navigation systems to enhance navigation accuracy in high latitudes;

• more capable ECM systems;

• ***Ekran*** (Screen) built-in test equipment/crew alerting system (BITE/CAS).

The MiG-31B (*izdeliye* 01B) superseded the MiG-31 (*izdeliye* 01DZ), to which it was outwardly all but identical, on the production line in 1990. The product code was later changed to *izdeliye* 12.

Mikoyan MiG-31BS long-range interceptor (*izdeliye* 01BS)

Concurrently the Mikoyan OKB and the Soviet Air Force launched an MLU programme to upgrade existing MiG-31s *sans suffixe* to MiG-31B standard. The work was performed by the Gor'kiy (or rather Nizhniy Novgorod) 'Sokol' (Falcon) aircraft factory. These aircraft shared the avionics/weapons fit of the MiG-31B but lacked the latter version's IFR probe, which could only be fitted to new-build aircraft with a revised forward fuselage structure. Thus the capabilities of existing MiG-31s were enhanced at minimum cost.

By analogy with the MiG-25PDS, the updated *Foxhound-As* were designated MiG-31BS, the S denoting *stroye**voy*** (operational – or, in this context, in-service upgrade) to discern them from new-build MiG-31Bs. Outwardly the aircraft was unchanged; you had to look into the cockpits to distinguish it from the original MiG-31 *sans suffixe*.

Tupolev Tu-128 long-range interceptor (*izdeliye* I, *Fiddler*)

Developed to meet a requirement formulated by the PVO's fighter arm in 1957, the Tupolev '128' long-range interceptor was almost the private initiative of Andrey N. Tupolev's OKB-156 at first; it was not until 1958 that the project gained official status. On 4th June and 28th August that year the Council of Ministers issued two directives ordering the development of the Tu-28-80 aerial intercept weapons system.

Initially referred to in official paperwork as the Tu-28, the new supersonic long-range patrol interceptor was a large (almost bomber-sized) aircraft powered by two 10,100-kgp (22,270-lbst) Lyul'ka AL-7F-2 afterburning turbojets. The avionics design bureau headed by Fyodor F. Volkov supplied the RP-S Smerch fire control radar, while the Bisnovat OKB was responsible for the K-80 AAM; the latter came in two versions (semi-active radar homing for attacks in head-on mode and IR-homing for attacks in pursuit mode). The radar had a 50-km (31-mile) target acquisition range and a lock-on range of 30-40 km (18.6-24.8 miles).

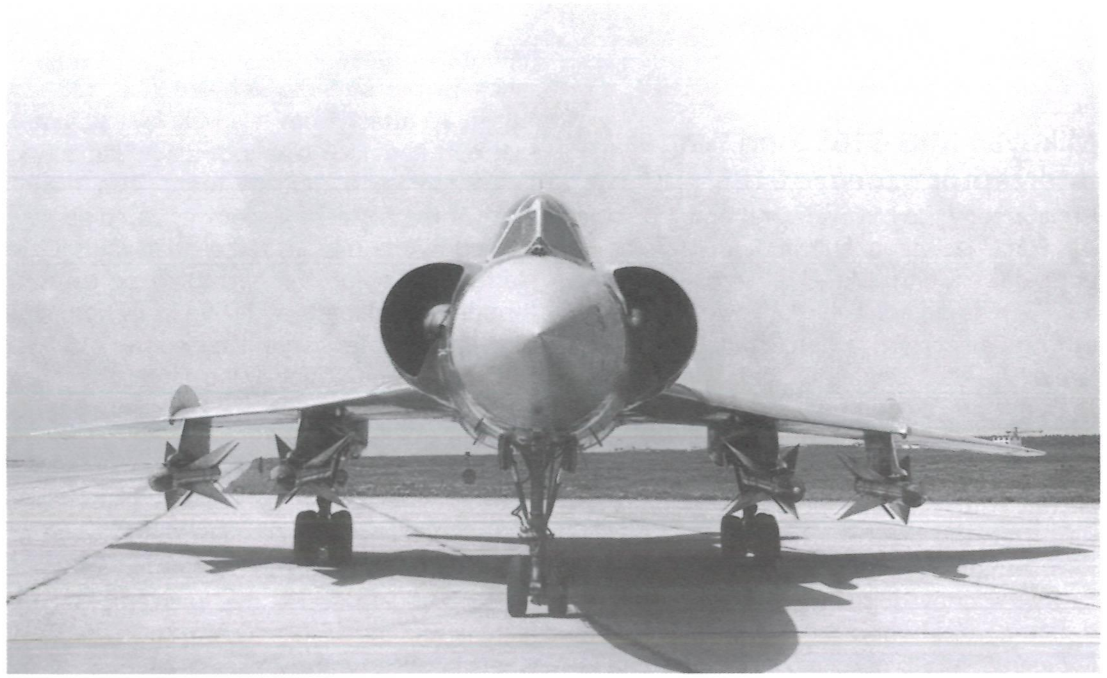
A peculiarity of the Tu-28-80 weapons system was that, unlike most contemporary interceptors, the aircraft did not need to climb to the target's own flight level; the K-80's long range and ability to destroy targets flying at much higher altitudes allowed the '128' to launch an attack from relatively low altitude (that is, it had 'look-up/shoot-down' capability, to paraphrase a modern term). This meant most of the high-G manoeuvres could be performed by the missiles rather than the missile platform, allowing the aircraft to be stressed for operational loads of 2-2.5 Gs; by comparison, the missiles were stressed for 15 Gs. When attacking a high-flying target the interceptor would pull up into a 20° climb. The K-80 was the first Soviet AAM with all-aspect engagement capability. It was designed to destroy manoeuvring targets flying at speeds up to 2,000 km/h (1,240 mph) and altitudes of 8,000-21,000 m (26,250-68,900 ft) – that is, up to 8,000 m above the interceptor's own flight level; the launch range could be anywhere between 2 and 25 km (1.24-15.5 miles).

Another special feature of the Tu-28-80 weapons system was the long range and endurance of the aircraft itself. The interceptor was capable of loitering in the area of the anticipated attack for 3-3.5 hours. This took the maximum interception range as far as 1,500 km (931 miles) from the target, allowing incoming bombers or cruise missiles to be destroyed even before they had a chance to enter Soviet airspace. Ground-controlled intercept was enabled by the Vozdukh-1M automated GCI system via the Kaskad-M and ARL-SM data link systems. However, the Smerch radar's long target acquisition and tracking range obviated the need to use GCI systems, enabling operations in areas where such systems were non-existent or too expensive to field (the High North, Siberia and the Soviet Far East).

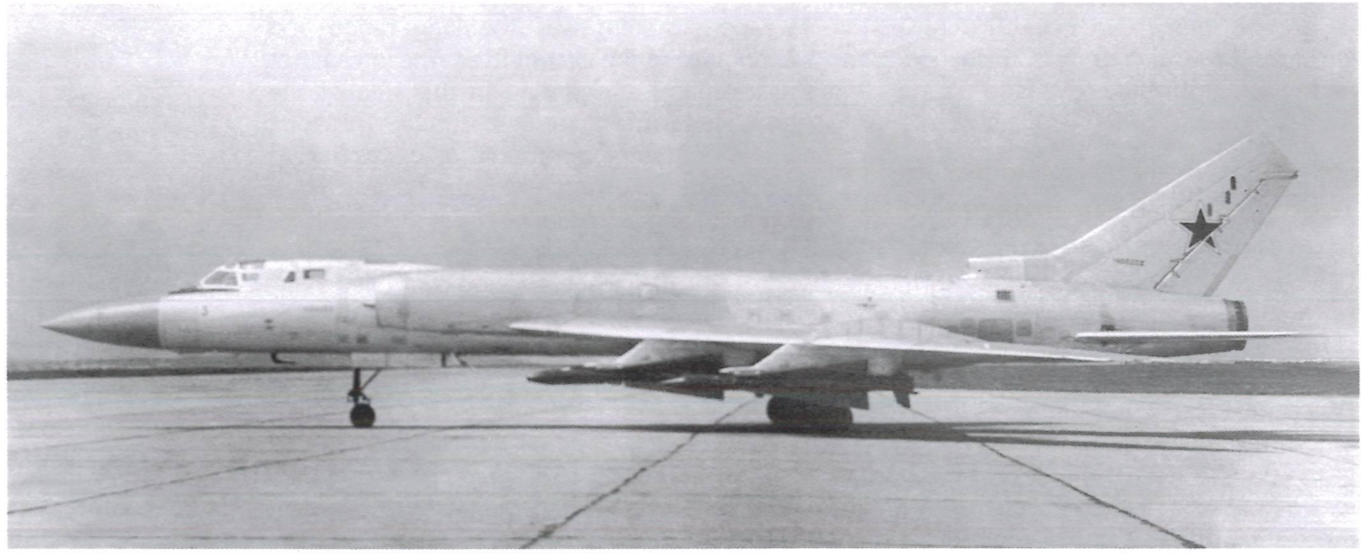
The '128' had a crew of two. The WSO handled many of the operations associated with the actual intercept, such as IFF interrogation and target lock-on, easing the pilot's workload; he also acted as the navigator, which is especially important during lengthy missions over areas lacking natural landmarks, and maintained radio communications. The pilot (or captain) would fly the aircraft, guide it to the target (once the latter had been located), using radar imagery or GCI guidance, and perform the actual missile launches.

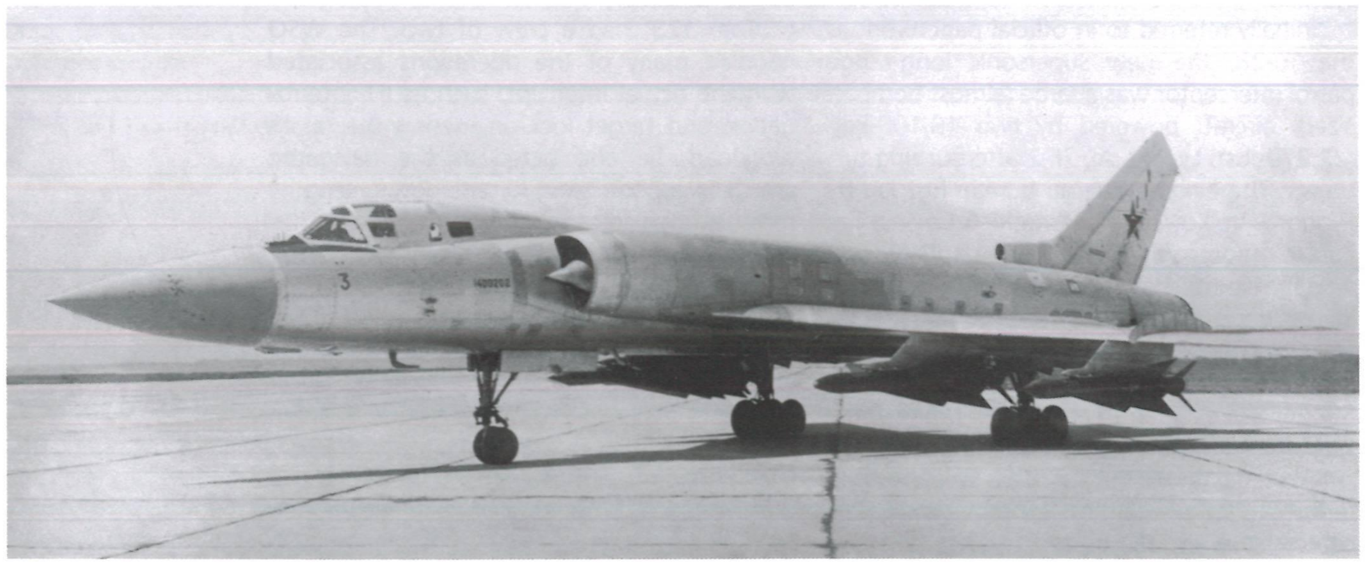
The '128' (Tu-28) interceptor's maiden flight took place on 18th March 1961. Manufacturer's flight tests continued throughout the year. Also in 1961 the aircraft entered production at factory No.64 in Voronezh with

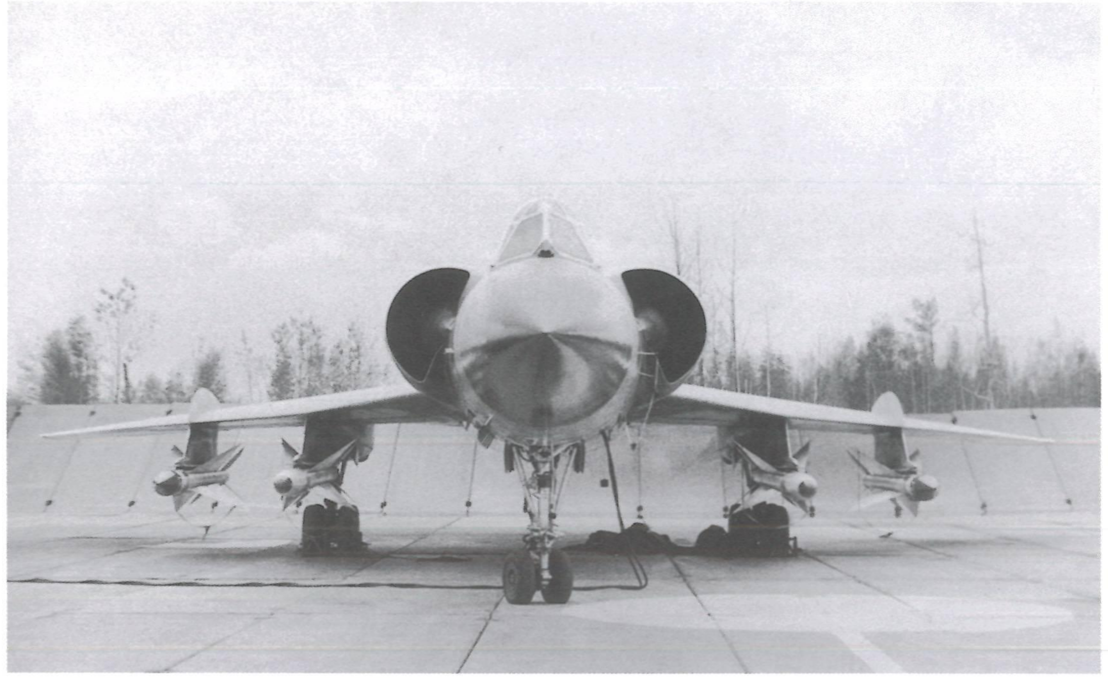
Head-on view of a Tu-128, showing the semi-circular air intakes and the four R-4 long-range AAMs under the wings.



Two more views of the same Tu-128. The R-4R (outboard) and R-4T (inboard) missiles are inert rounds painted bright red.



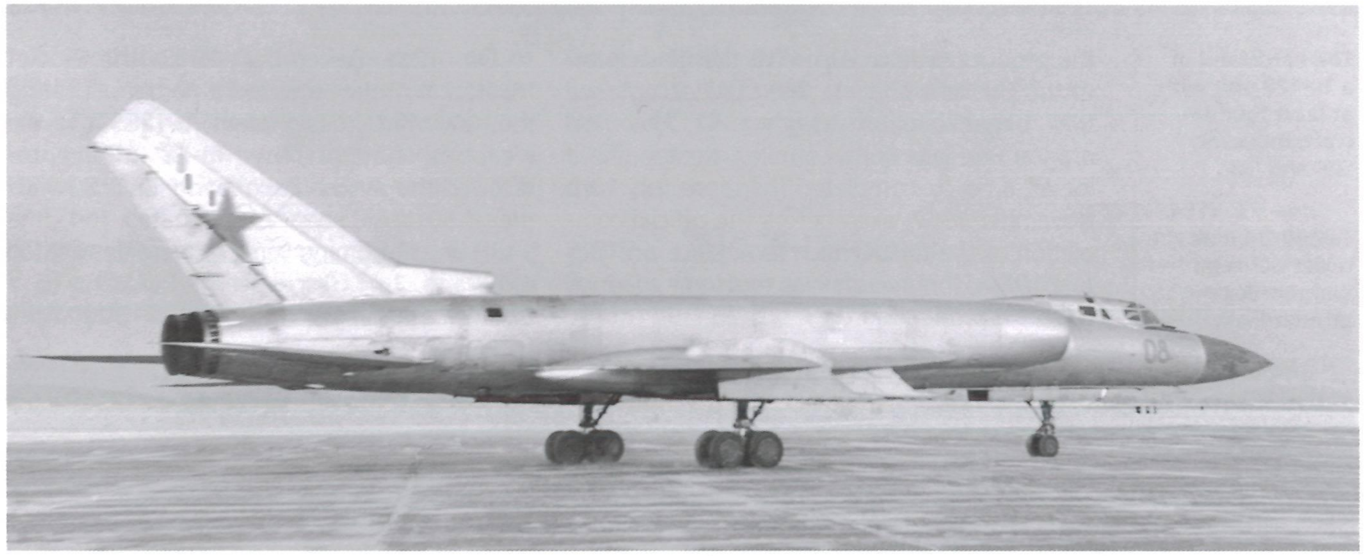


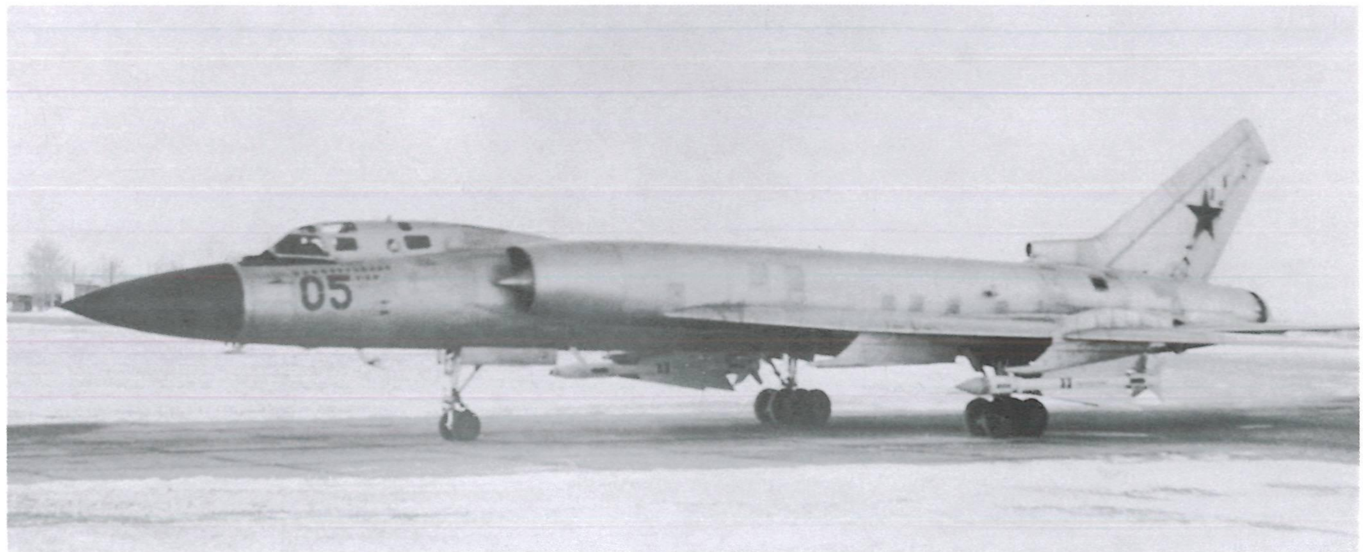


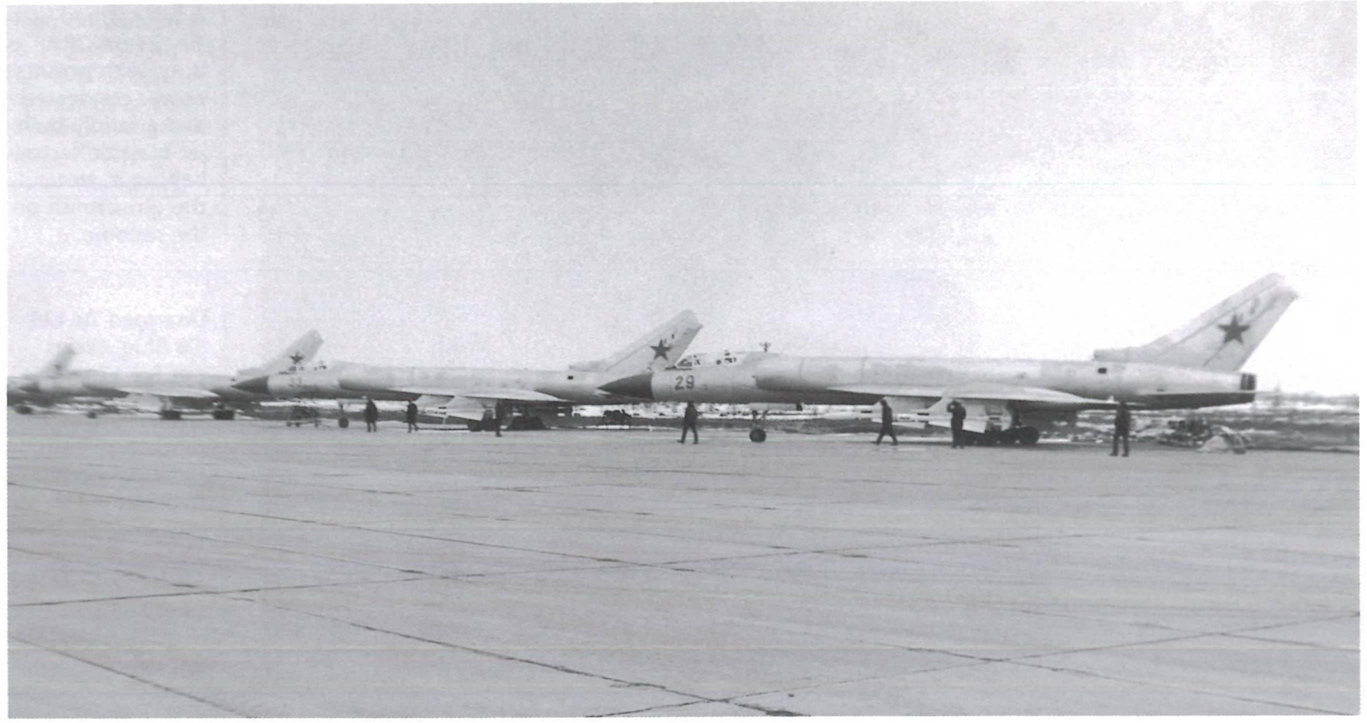
A fully armed Tu-128 on QRA duty, with ground power connected and a solidly built jet blast deflector behind it. Note the gloss finish on the radome.

Unarmed Tu-128 '08 Blue' taxies out for a practice flight.

Tu-128 '05 Blue' shown as it vacates the runway after landing sports no fewer than 15 'kill' stars'.







The hardstand of a Tu-128 unit with at least four aircraft, including '29' and '33'.

Tu-128 '34 Blue' taxies out with two missiles attached.

the product code *izdeliye* I (И, the ninth letter of the Cyrillic alphabet). The state acceptance trials began on 20th March 1962. The trials programme was quite complex, demanding a lot of time to complete. Therefore, on 10th November 1962, even before the official completion of the trials (which took place on 13th July 1964), the aircraft was recommended for full-scale production.

On 12th December 1963 the Soviet Minister of Defence issued an order allocating the new official designation Tu-128S-4 to the weapons system. The Tu-28 interceptor received the service designation Tu-128, while the K-80 AAM was redesignated R-4 (the SARH and IR-homing versions were designated R-4R and R-4T respectively). Pursuant to a Council of Ministers directive of 30th April

Seen with the landing gear in mid-retraction, this Tu-128 carries the missiles in a lop-sided arrangement (on the port inboard and starboard outboard stations).

1965 and the Minister of Defence's order of 8th June 1965 the Tu-128S-4 weapons system was officially included into the inventory.

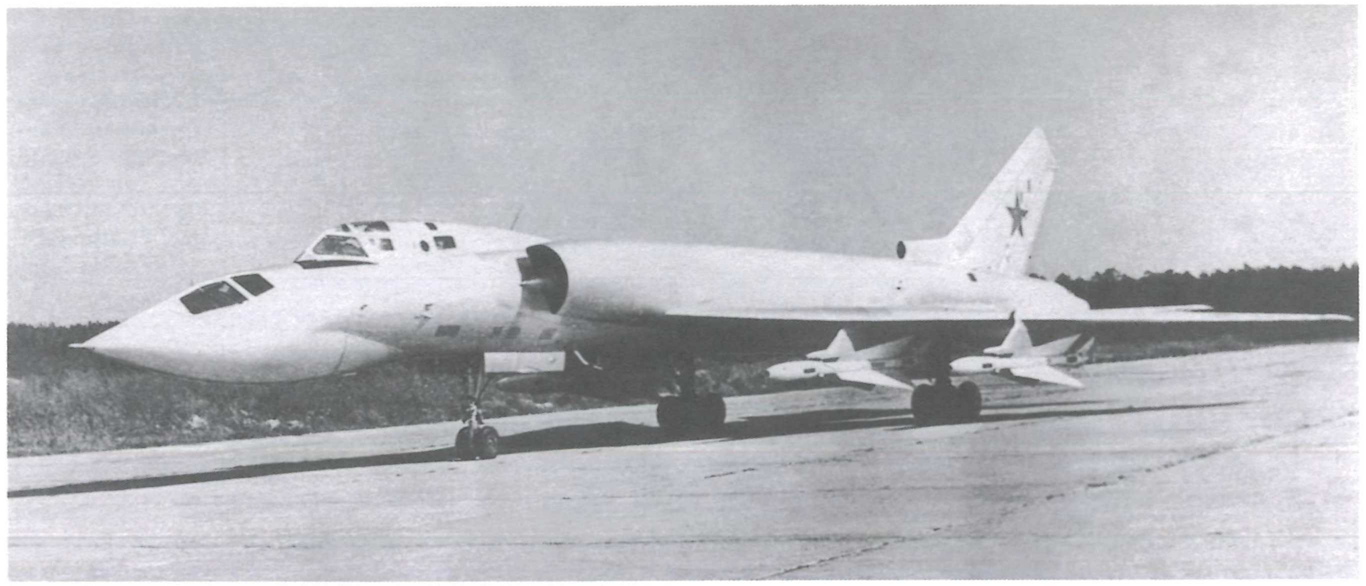
Plant No.64 achieved the intended full-scale production rate in 1966. A total of 188 Tu-128s rolled off the Voronezh assembly line between 1962 and 1970.

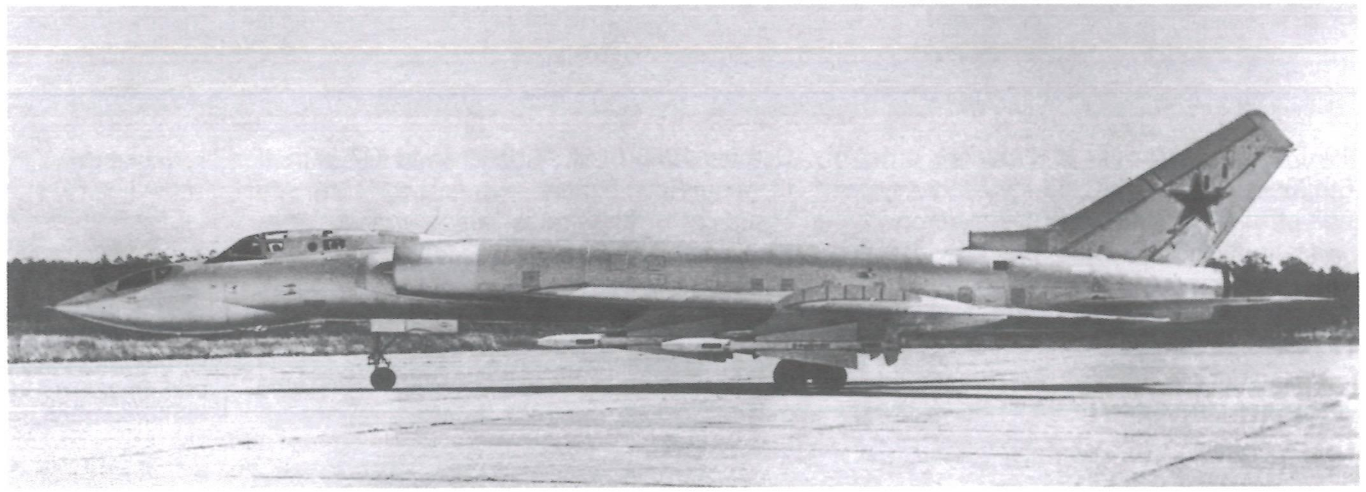
The PVO's 148th TsBP i PLS at Savasleyka AB took delivery of its first Tu-128s in 1964. In October 1966 the Tu-128 achieved IOC with a first-line PVO fighter unit – the 445th AP based at Arkhangel'sk-Talagi airport. The NATO reporting name was *Fiddler*.

Tupolev Tu-128UT trainer

Before accepting the first production batches of the Tu-128 the PVO Aviation command

Tu-128 '11' at a northern airbase, with ground support equipment in the foreground.





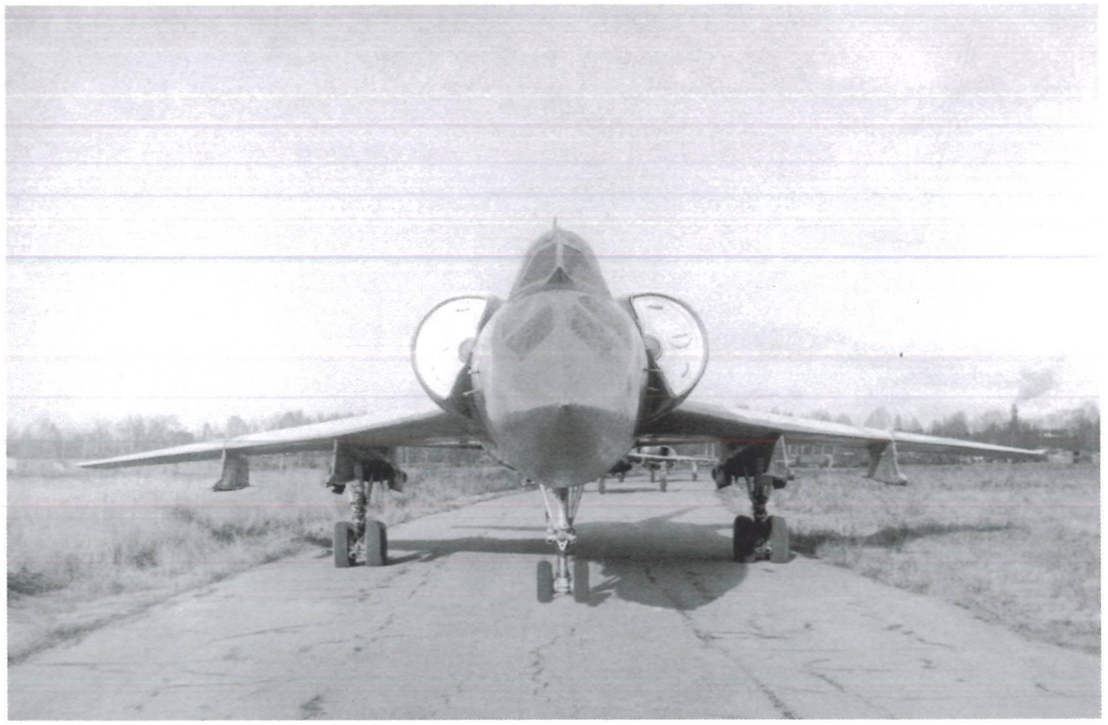
Having no radar, the Tu-128UT could carry only R-4T IR-homing AAMs.

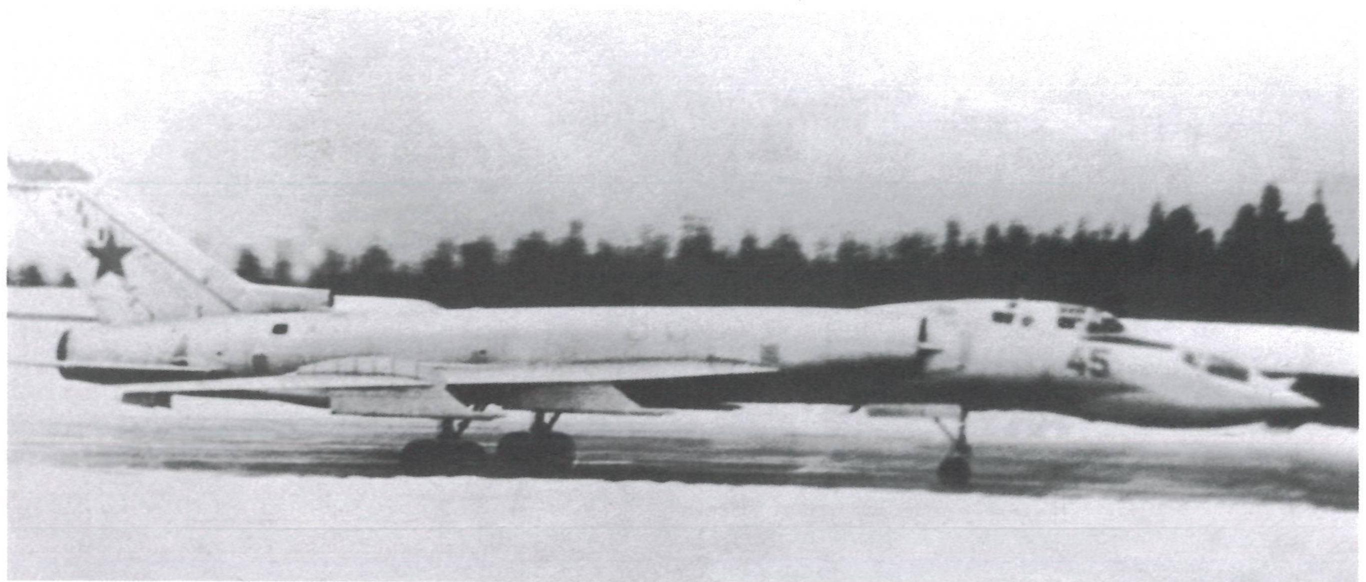
Front view of a Tu-128UT.

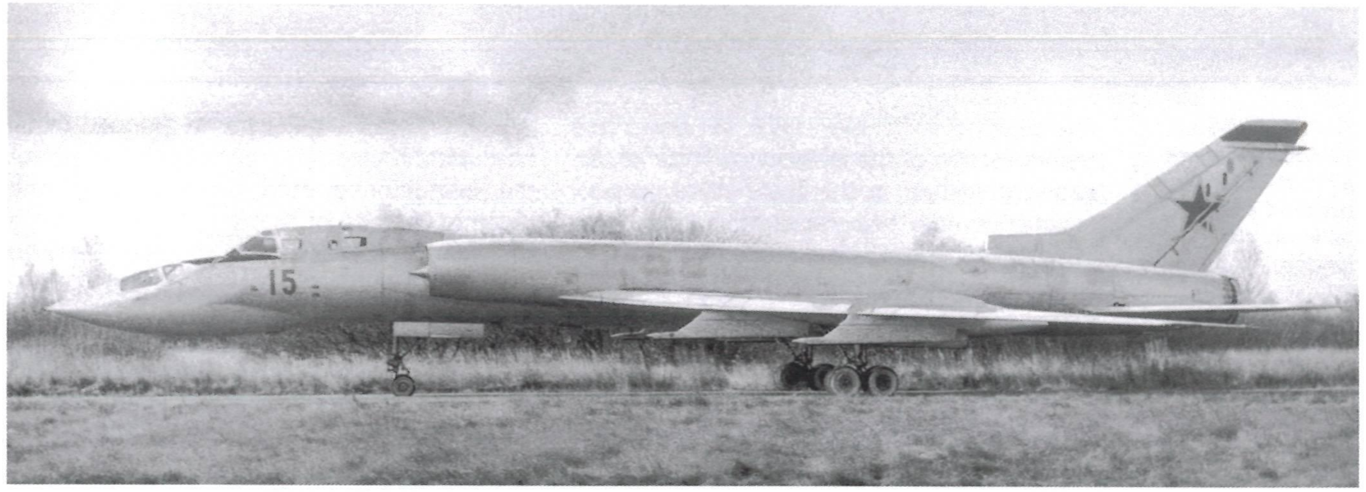
Opposite, top to bottom: Tu-128UT '45' seen shortly after landing (note the brake parachute bay doors).

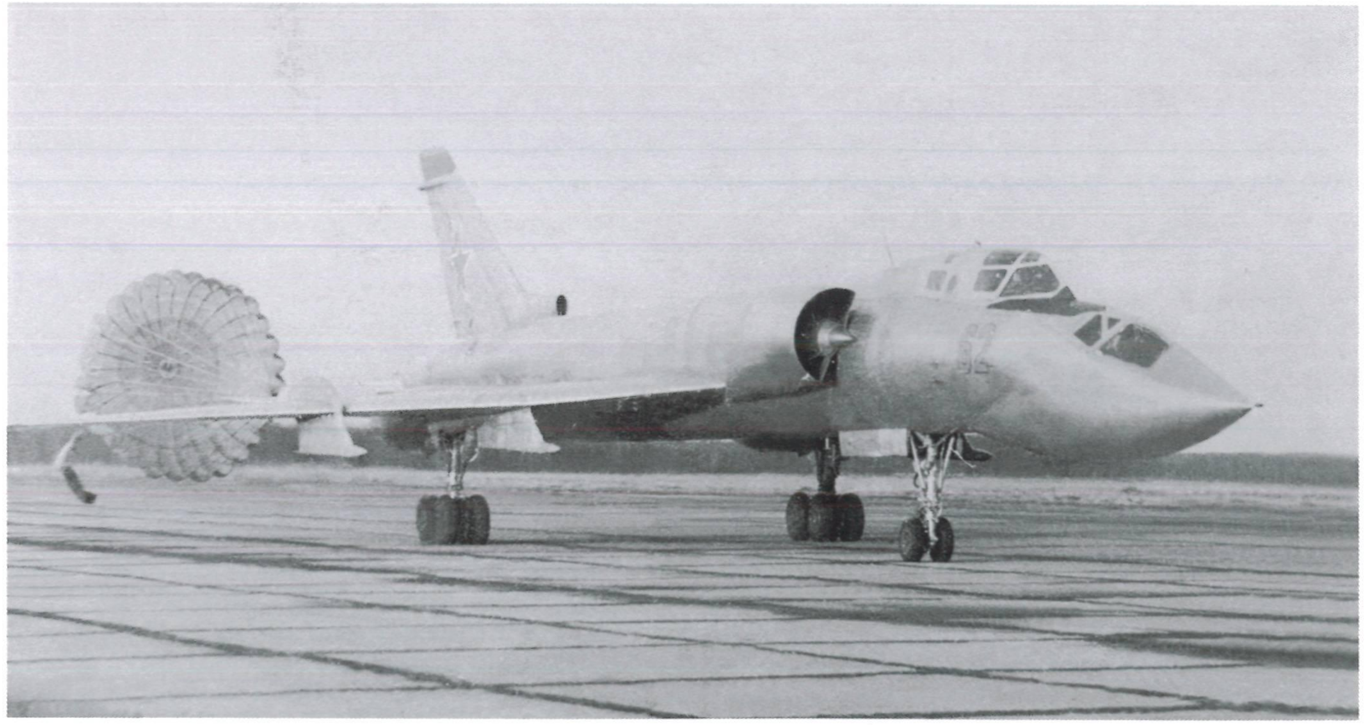
Tu-128UT '15 Red' with painted 'whitewall tyres'.

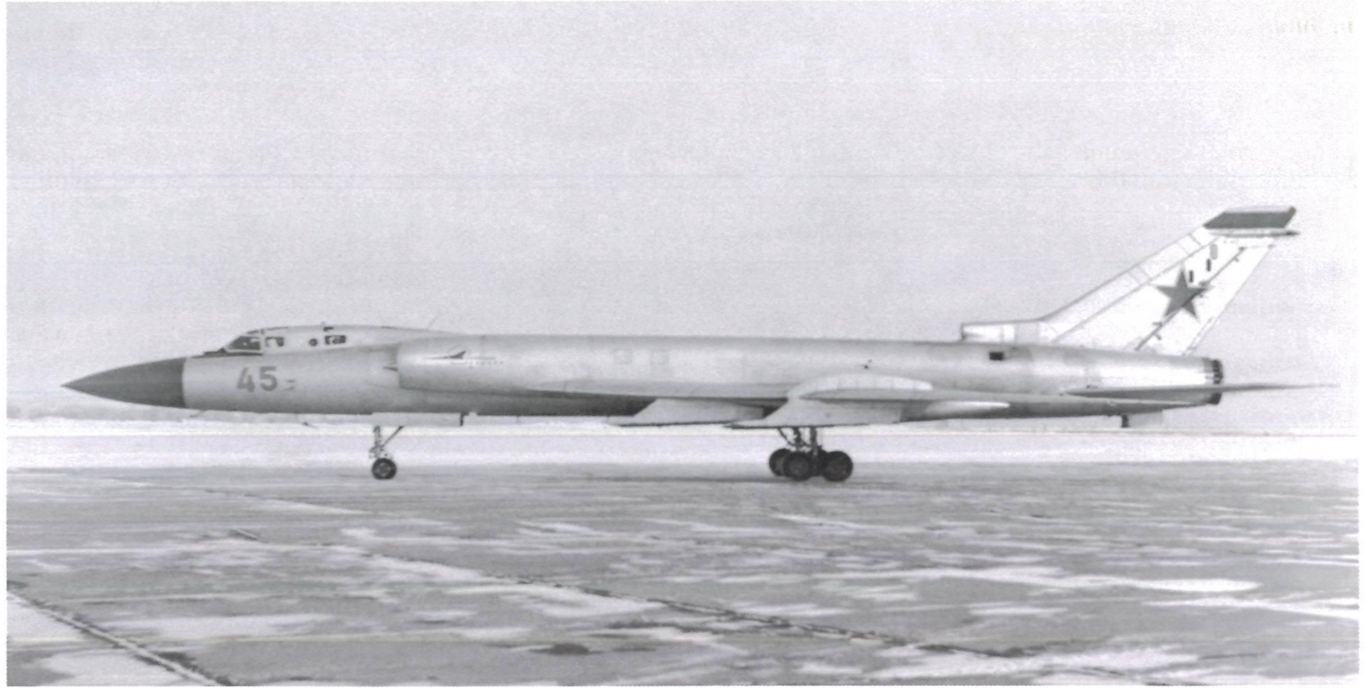
Tu-128UT '62 Blue' with the brake 'chute deployed.











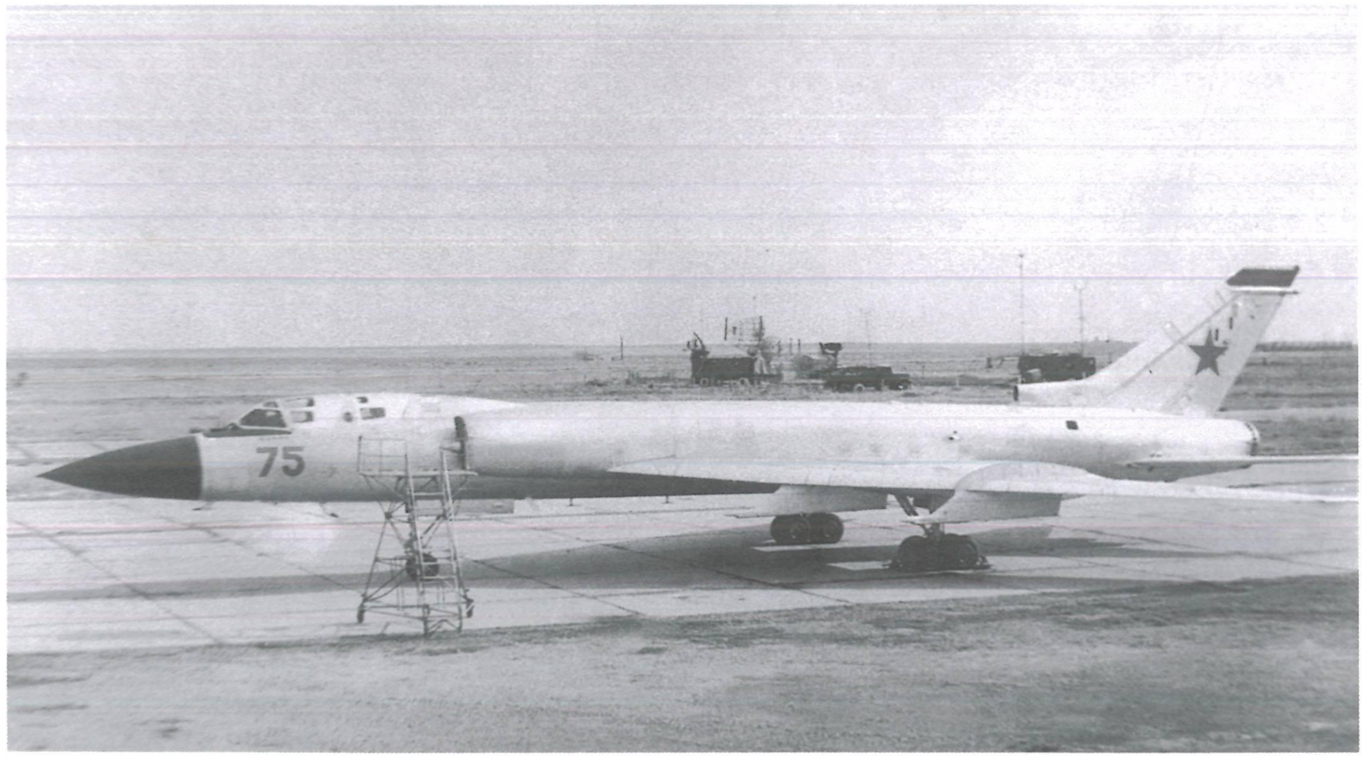
Tu-128M '45 Blue' with an 'Excellent aircraft' badge on the port intake taxies in after landing.

'75 Blue' was one of the first Tu-128Ms to be delivered.

requested the Tupolev OKB to develop a trainer version of the interceptor. After all, the pilots converting to the Tu-128 had no prior experience with heavy aircraft, having previously flown single-seat fighters, and the subsonic Tu-124Sh *Cookpot* navigator trainer used for conversion training as a stop-gap measure was no match for the *Fiddler* in terms of performance.

Designated Tu-128UT (*oo**chebno**-treni-**rov**ochnyy* – for conversion/proficiency training), the trainer version had a drooped metal nose section incorporating a third cockpit for the instructor grafted on instead of the radome. Because of its distinctive nose profile the aircraft was inevitably dubbed *Peli**kahn*** (Pelican).

The Tu-128UT entered flight test in the first quarter of 1971. That same year the Voronezh aircraft factory built ten production trainers. The Tu-128UT proved to be a valuable asset for the PVO, facilitating the conversion of



crews to the new type, especially the mastering of the take-off and landing techniques.

Tupolev Tu-128M long-range interceptor (*izdeliye* IM, *Fiddler*)

The work aimed at improving the Tu-128S-4 aerial intercept weapons system culminated in the late 1960s in a three-stage upgrade programme. The need for it was dictated by a change in the tactics used by the potential adversary's strike aviation, which now resorted to low-level and ultra-low-level penetration. Another factor was the addition of air-launched cruise missiles to the USAF inventory; flying at ultra-low level and following the

The 514th ARZ museum in Rzhev has both a Tu-128 and a Tu-128M.

Tu-128 '71 Blue' is in the PVO Aviation Museum at Savasleyka AB.

The T43-15 was one of the Su-9 development aircraft. Note the differently coloured RS-2-US missiles on the inboard and outboard pylons.

terrain, they could cover distances of several thousand miles.

Stage One envisaged reducing the minimum target interception altitude from 8,000-10,000 to 500-1,500 m (from 26,250-32,800 to 1,640-4,920 ft), as well as improving the ECM resistance of the R-4R missile's SARH seeker head. Stage Two envisaged increasing the maximum target intercept altitude from 21,000 to 23,000-25,000 m (from 68,900 to 75,460-82,020 ft), increasing the maximum target speed in a 'crossing shot' engagement from 2,000 to 3,000 km/h (from 1,240 to 1,860 mph), further improving ECM resistance and increasing the system's automatic/semi-automatic intercept capability. At this stage target acquisition range was to be increased from 50 to 90-100 km (from 31 to 56-62 miles), lock-on range from 35-40 to 60-70 km (from 21.7-24.8 to 37-43.5 miles) and missile launch range from 20-25 to 35-40 km (from 12.4-15.5 to 21.75-24.85 miles). Maximum target elevation was to be increased from 7,000-8,000 to 10,000-12,000 m (from 22,965-26,250 to 32,800-39,370 ft).

Stage Three was entirely concerned with the aircraft as a missile platform. The designers intended to raise the Tu-128's top speed with four missiles from 1,665 to 2,100-2,400 km/h (from 1,034 to 1,304-1,490 mph). Other objectives included improving acceleration, reducing the take-off run and extending range.

The Tupolev OKB set to work on the tasks envisaged by Stage One. On 26th December 1968 the Council of Ministers issued a directive concerning the Tu-128S-4M weapons system. In keeping with this document operational Tu-128 interceptors were to be modified to Tu-128M standard. The upgraded aircraft were to feature a new RP-SM (Smerch-M) fire control radar and be armed with new R-4RM and R-4TM missiles.

The first prototype Tu-128M made its maiden flight on 24th September 1970. State acceptance trials of the Tu-128M and the Tu-128S-4M weapons system began on 5th August 1970, continuing until 24th July 1974. The results were good, and on 28th June 1979 the Tu-128S-4M weapons system was officially included into the PVO inventory.

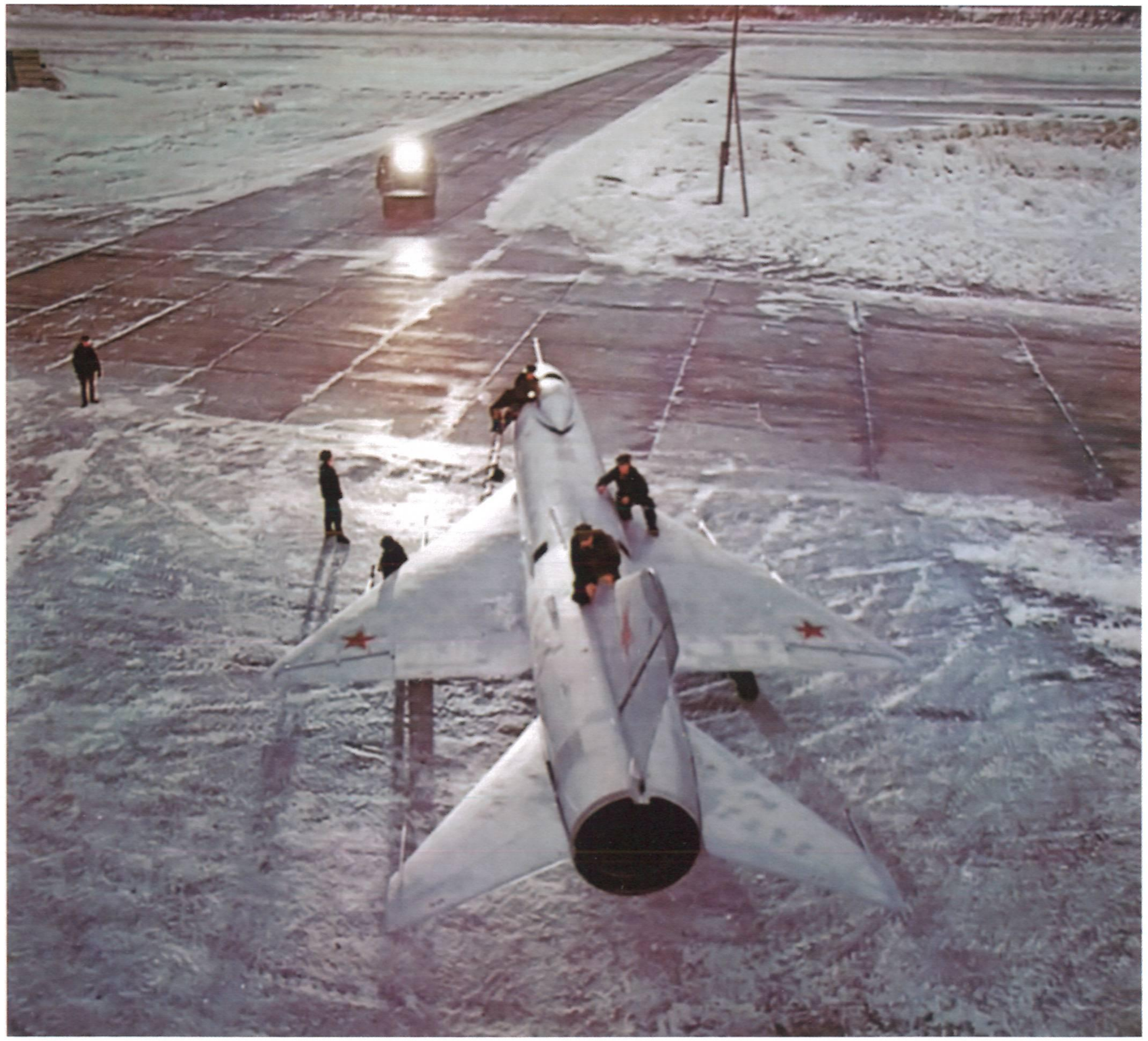
The conversion of operational *Fiddlers* to Tu-128M standard took place at aircraft repair plants. Apart from the new radar and reinforced wing hardpoints to cater for the heavier R-4RM/R-4TM missiles, other systems were upgraded, including the communications suite which featured an R-846 Prizma-M radio; accordingly the fin was modified to feature a horizontally cropped tip with a dielectric fairing. The entire fleet was upgraded to Tu-128M standard within a relatively short time. The Tu-128M remained operational until the late 1980s when it was succeeded by the MiG-31.

Sukhoi Su-9 interceptor (T-43, *izdeliye 27/izdeliye* 34, *izdeliye* 10; *Fishpot-B*)

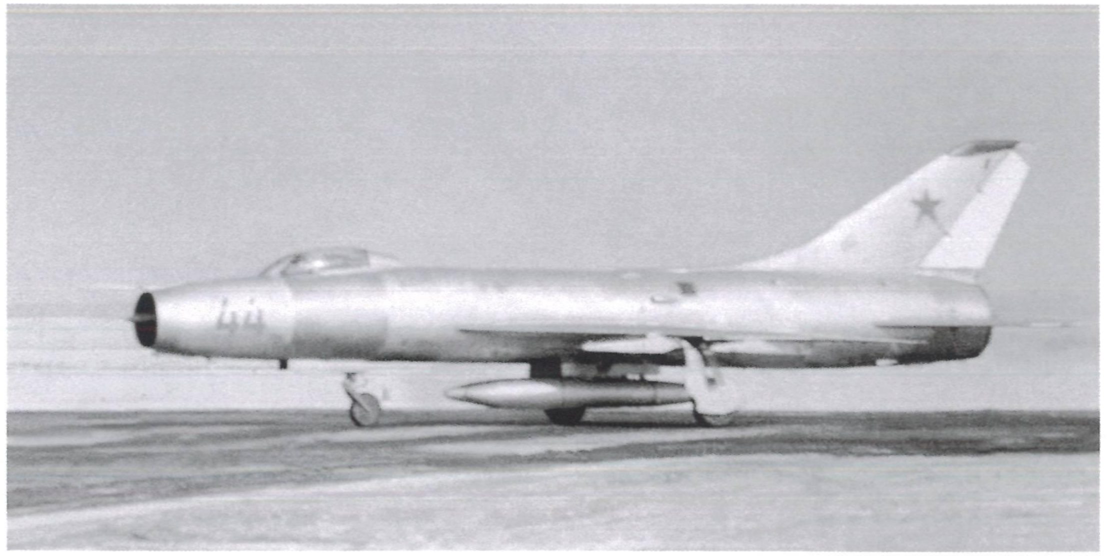
After the successful tests of the T43-1 development aircraft first flown on 10th October 1957 (a derivative of the T-3 delta-wing interceptor prototype featuring an uprated AL-7F-1 turbojet and a new sharp-lipped axisymmetrical air intake with a conical centrebody) the OKB-51 led by Pavel O. Sukhoi concentrated on two main areas of work, one of which was to achieve a satisfactory radar installation. The only suitable option was the TsD-30 fire control radar developed by OKB-1, a division of the Ministry of Defence Industry. It was small enough to fit inside the T-43's movable shock cone; another major point in favour of this radar was that the TsD-30 was optimised for guiding the K-5 semi-active radar homing AAM (known in service as the RS-1-U) was the only air-to-air missile included into the Soviet Air Force's inventory by 1957. On 28th November the Council of Ministers issued a directive requiring the Sukhoi OKB to equip the AL-7F-1 powered T-3 interceptor with the TsD-30 radar and arm it with K-5M (RS-2-U) missiles. The weapons system built around these components was designated T-3-51.

OKB-2 adapted the K-5M (RS-2-U) missile to the T-43; resulting version was designated K-5MS, the S standing for Sukhoi. The missiles were carried on four permanently installed pylons under the wings. Also, the aircraft was fitted with the Lazoor' data link system forming part of the Vozdukh-1 GCI system.

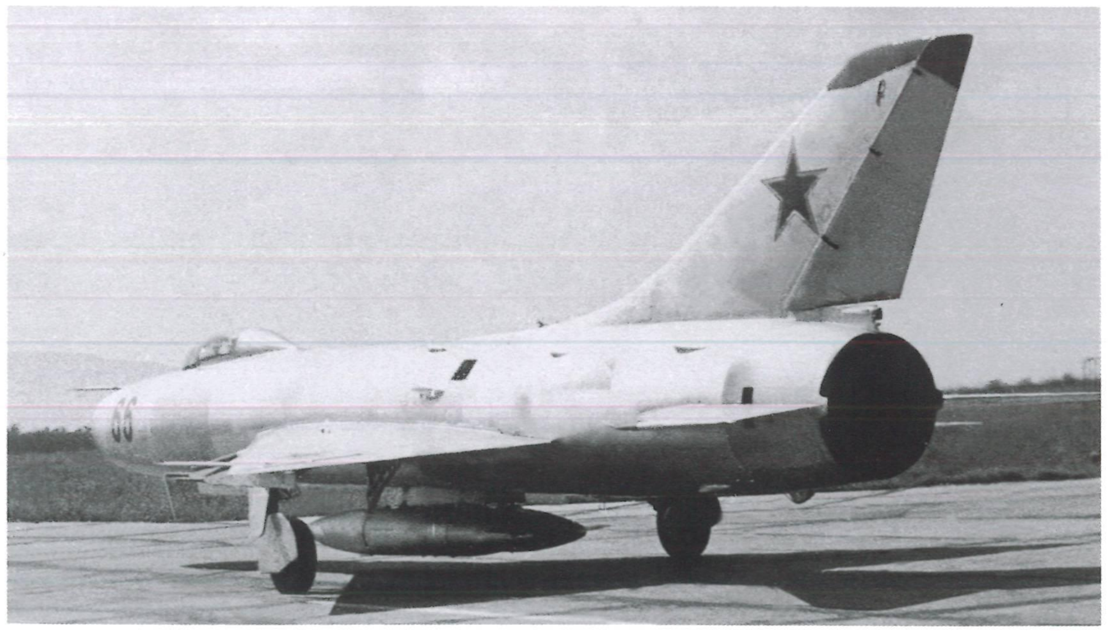
Using an APM-90 mobile searchlight mounted on a ZiL-130 dropside lorry to provide illumination, technicians prepare a Su-9 for a night sortie at a snow-covered airbase.



An operational Su-9 coded '17' carries a full load of four RS-2-US AAMs and two drop tanks.



Su-9 '44' taxies with a pair of drop tanks but no missiles.



'66 Blue', another operational Novosibirsk-built Su-9.

Flight tests of the interceptor in this configuration began in May 1958, using five prototypes. On 30th August that year the T-43 was submitted for state acceptance trials. Stage A of the T-3-51 weapons system's state acceptance trials began on 3rd December 1958, continuing until May 1959; Stage B held jointly by the OKB and the Air Force lasted from June 1959 to April 1960. The trials proceeded with a fair share of problems, notably with the powerplant and the air intake control system. To cure the engine's propensity to surging at supersonic speeds, the ESUV-1 electrohydraulic air intake control system was introduced in January 1959.

The trials were concluded on 9th April 1960, virtually all of the performance targets being met. In particular, the aircraft was capable of destroying targets flying at speeds of 800-1,600 km/h (495-990 mph) and altitudes of 5,000-20,000 m (16,400-65,620 ft) with a 'kill' probability of 70-90%; the maximum radius of action (intercept range) was 430 km (267 miles) instead of the specified 400 km (248 miles). On 15th October 1960 the T-3-51 aerial intercept weapons system was cleared for service; in so doing the T-43 interceptor received the service designation Su-9, the TsD-30 radar became the RP-9U, the K-5MS missile was redesignated RS-2-US and the system as a whole was renamed Su-9-51.

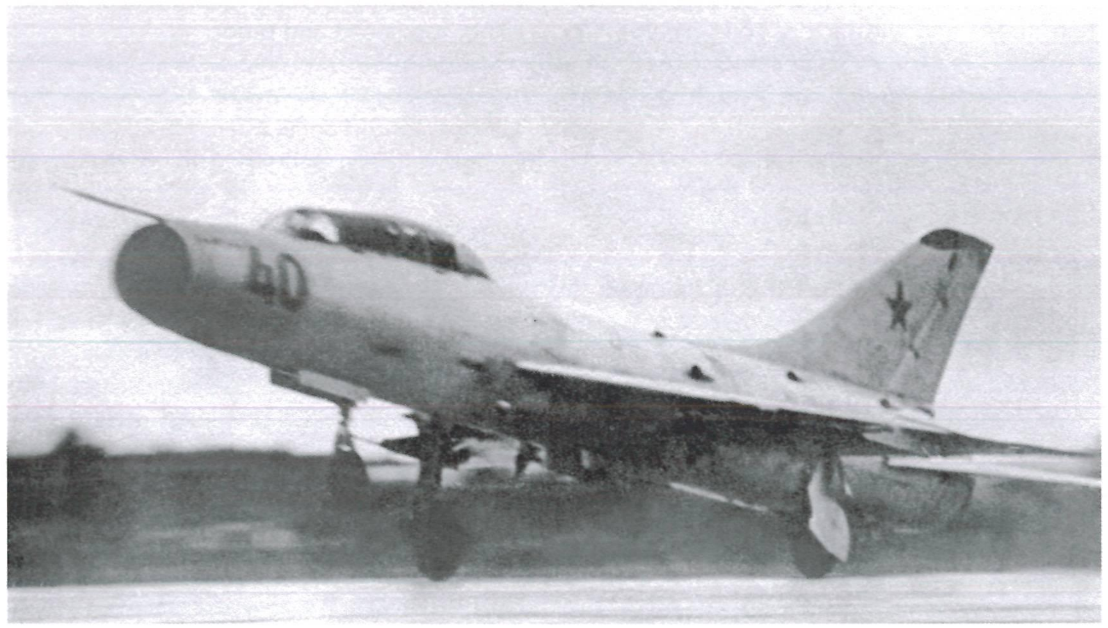
Production of the Su-9 at the Novosibirsk aircraft factory No.153 commenced in 1958, continuing until 1962. Initially the Su-9 retained the factory product code of the original T-3 (*izdeliye* 27) but this was later changed to *izdeliye* 34; in Sukhoi OKB paperwork the aircraft was still referred to as the T-43 – or even as the T-3 (!).

Additionally, the interceptor was built at MMZ No.30 'Znamya Trooda' (*Mos**kov**skiy ma**shin**ostro**it**el'nyy za**vod*** – Moscow Machinery Plant No.30 'Banner of Labour') in 1959-61 as *izdeliye* 10. Between them the two plants completed just over 1,000 single-seat interceptors. The Su-9 received the NATO codename *Fishpot-B*.

Despite persistent efforts by the OKB and the plants, the Su-9's reliability record was poor and the accident rate was high. The situation appeared strange; the Su-9's operational reliability was far lower than that of the Su-7 fighter-bomber sharing basically the same fuselage and tail unit, the same engine and many equipment items. Of course, this undermined the image of the aircraft as a whole; the 'head office' (that is, OKB-51), not the suppliers of this or that component, got the blame.

Alarmed by this situation, the military started demanding that something be done about it. In February 1961 a special investigative commission started working in IA PVO units. Based on the commission's findings, Su-9 operations came to an almost complete standstill. The aircraft industry showed no reaction at first, but the accidents continued, and the military finally ran out of patience.

By 1965 the situation had improved, as the main bugs had been ironed out. Various changes introduced into the design of the Su-9 in the course of production included a radar modified to improve target tracking reliability, integral tanks in the forward fuselage and in the wing roots increasing total internal



A Su-9U trainer pictured at the moment of rotation before take-off.

fuel capacity from 3,060 to 3,780 litres (from 673.2 to 831.6 Imp gal), and more refined ejection seats.

The interceptor's armament received attention as well. In addition to the beam-riding RS-2-US missiles, operational aircraft were armed with an IR-homing version of the missile. Originally known as the K-55, this was redesignated R-55 in service and the modified radar compatible with the R-55 was designated RP-9UK.

Until the late 1960s, when the Soviet Air Force started taking delivery of the new MiG-25P interceptor, the Su-9 was the Soviet Union's fastest and highest-flying combat aircraft.

Sukhoi Su-9U combat trainer (U-43, *izdeliye* 11, *Maiden*)

A two-seat combat-capable conversion trainer variant of the Su-9 was developed in 1960 as the U-43 (U = *oo**cheb**nyy* [*samo**lyot***] – trainer). To accommodate a second cockpit for the instructor the fuselage was stretched by 600 mm (1 ft 11⅝ in). The trainee and the instructor sat in tandem under a common canopy featuring individual aft-hinged portions. The U-43 retained the single-seater's avionics suite.

The trainer made its first flight on 25th January 1961 with Yevgeniy K. Kukushev at the controls. State acceptance trials were completed on 23rd December; with two RS-2-US AAMs the U-43's acceleration parameters and service ceiling were almost identical to those of the single-seat Su-9 with four missiles.

The aircraft received the service designation Su-9U and the factory code *izdeliye* 11; the NATO reporting name was *Maiden*. Only 50 production Su-9Us were built by MMZ No.30 in 1961-62.

Sukhoi Su-11 interceptor (*izdeliye* 36, *Fishpot-C*)

In parallel with the effort that culminated in the Su-9, the Sukhoi OKB worked on equipping the T-3 interceptor with the powerful *Al**maz*** (Diamond) fire control radar, the resulting aircraft received the manufacturer's designation T-47. Again, the radar (this time featuring separate search and tracking antennas) was placed inside a large conical centrebody within an axisymmetrical air intake. The latter was of significantly larger diameter and two dielectric panels were incorporated on the sides of the nose to ensure an acceptable directional pattern for the radar's search antenna.

On 18th December 1957 the Novosibirsk aircraft factory No.153 received orders to manufacture an initial batch of ten T-47 interceptors in 1958. The aircraft were to be armed with two NR-30 cannons and two ORO-57 rocket pods for 57-mm (2.24-in) ARS-57 folding-fin aircraft rockets; no missiles were envisaged at first. The first prototype (the T47-1) performed its maiden flight on 6th January 1958. Soon, however, the cannon-armed version was dropped and all efforts were directed towards more advanced weapons systems.

The *O**ryol*** (Eagle; NATO *Skip Spin*) radar developed by OKB-339 as a derivative of the Yak-25's RP-6 ***Sok**ol* (Falcon) radar seemed more attractive than the competitors – first and foremost because it featured a single antenna. The radar worked with the K-8 AAM developed by OKB-4 under Matus R. Bisnovat; this advanced missile had much greater range than the K-5M and, importantly, came in both SARH and IR-homing versions. OKB-4 was tasked with developing a 'Sukhoi version' of the missile designated K-8-2 (or K-8M).

Detail design of the interceptor featuring the Oryol radar and K-8M missiles began in the second half of 1958. The first aircraft to converted to this configuration under the T-3-8M programme (that is, T-3 armed with K-8M missiles) was the T47-3. Manufacturer's flight tests began on 25th December 1958. The early test results showed that the redesigned forward fuselage adversely affected flight performance, causing a deterioration of the acceleration parameters, service ceiling, top speed and range.

Three other prototypes were converted from T-3s in 1958-59. On 17th September 1959 the T-3-8M aerial intercept weapons system was officially submitted for state acceptance trials. Stage A of the trials lasted from November 1959 to April 1960. Changes incorporated at this stage at the request of the military included an uprated AL-7F-2 engine delivering 10,100 kgp (22,270 lbst) in full afterburner and increased fuel tankage.

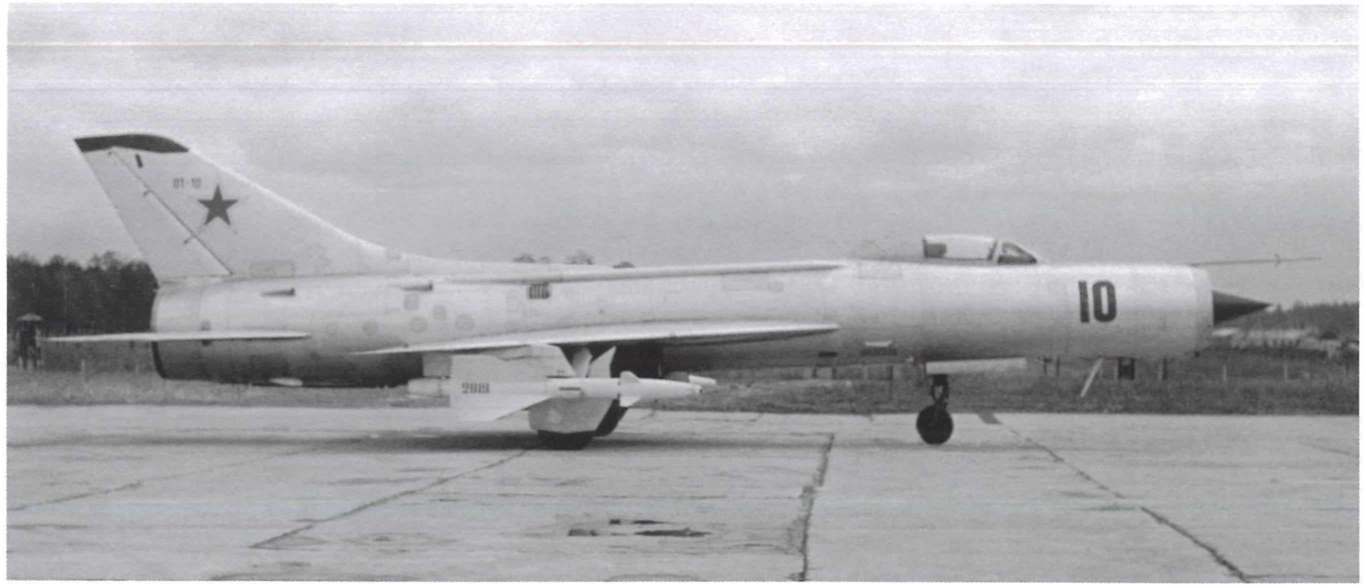
Stage B of the trials commenced on 26th April 1960 and was completed in late May 1961. On 5th February 1962 the T-3-8M weapons system was officially included into the PVO inventory. In so doing the T-47 interceptor received the service designation Su-11; its Oryol radar was designated RP-11, the K-8M AAM was redesignated R-8M and the weapons system as a whole was redesignated Su-11-8M.

The first production Su-11 built by plant No.153 took to the air in July 1962. Production Su-11s bearing the in-house product code *izdeliye* 36 featured an upgraded avionics and equipment suite; this included an RSIU-5V VHF communications radio, a new ARK-10 automatic direction finder, an ARL-S Lazoor' data link system working with the Vozdukh-1 GCI system, an MRP-56P marker beacon receiver, SOD-57M distance measuring equipment, an SRZO-2M Khrom-Nikel' (Chromium-Nickel) IFF interrogator/transponder, a Sirena-2 RWR, an AGD-1 artificial horizon and a KSI compass system. The aircraft also featured many systems components not found on the Su-9 (albeit some of them were later retrofitted to the latter type), namely an RV-UM low-range radio altimeter, a D-3K-110 yaw/pitch/roll damper, an AP-28Zh-1B autopilot and a new KS-3 ejection seat with a much wider operational envelope.

Production seemed to be going nicely when on 31st October 1962 a Su-11 crashed fatally during a test flight. Given the Su-9's high accident rate, this accident played into the hands of the Su-11's opponents. At the

A Su-9 uses its quadruple airbrakes to slow down after landing; the brake parachute line is just visible.

A Su-9 preserved at the ARZ-514 museum in Rzhev. The engine nozzle is blanked off



Three views of the tenth production Su-11 '10 Blue', with two heat-seeking R-8M missiles. The aircraft's c/n is stencilled on the tail as 01-10.

Su-11 '36 Blue' served as an instructional airframe at a PVO Junior Technical Specialists' School.

time aircraft designer Aleksandr S. Yakovlev enjoyed considerable influence in the government. As a result, Su-11 production was curtailed in favour of the competing Yak-28P interceptor.

In mid-1964, after a reliability improvement programme, the Su-11 finally achieved IOC with the PVO's 393rd GvIAP based near Astrakhan'. By then the Sukhoi OKB was commencing the trials of the future Su-15 on which it had placed its bets. As a result, only 108 Su-11s were completed until early 1965. Despite being built in such small numbers, the Su-11 soldiered on alongside the Su-9 until the early 1980s when the last examples were retired as time-expired. In the late 1960s the Su-11 fleet was upgraded by the addition of SARPP-12 flight data recorders, just as was the case with the Su-9.

Sukhoi Su-15 interceptor (T-58D, *izdeliye* 37; *Flagon-A*)

As an insurance policy in case the military rejected the single-engined Su-15 (T-58) interceptor project – which they did – in late 1960 the Sukhoi OKB prepared a new version with two 7,200-kgp (15,870-lbst) Metskhvarishvili R21F-300 afterburning turbojets side by side in the rear fuselage. The PVO's Main Headquarters was adamant that the twin-engined version (likewise known officially as the Su-15) was to be equipped with the new Vikhr'-P (Whirlwind) radar and armed with two K-40 AAMs, even though GKAT had pointed out that using the existing Oryol-2 radar and K-8M2 AAMs would allow the interceptor to enter service much sooner. The PVO also specified that the aircraft should have the proposed general arrangement with lateral intakes and an area-ruled fuselage.

The project of the twin-engined T-58 was finalised in 1961. The R21F-300 turned out to have serious design flaws, and when further development of this engine was terminated in 1962 the Sukhoi OKB chose to use the proven Tumanskiy R11F2-300 afterburning turbojets instead. The in-house designation was amended to T-58D, the suffix standing for either ***dvig**ateli* (engines), referring to the new powerplant, or *dora**bot**annyy* (modified or improved). Another important change occurred at this point; since the K-40 AAM had been selected as the main armament for the Mikoyan Ye-155P (the future MiG-25P),

Partly covered by tarpaulins, a Su-11 coded '34' awaits the next mission.

the PVO conceded that the T-58D (Su-15) would be armed with upgraded K-8M2 missiles, provided that a further improved version of the Oryol-2 radar was used; this version received a new name, ***Sob**ol'* (Sable).

The aircraft drew heavily on the design of the Su-9 and Su-11, from which it borrowed the pure delta wings and tail unit (suitably modified to match the different fuselage shape) and, basically, the landing gear. Thus the fuselage was the only major component designed from scratch. Since the new aircraft would be a lot heavier than the Su-11 while the wing area remained unchanged, the designers decided to use blown flaps to ensure acceptable field performance. The landing gear had to be reinforced to cater for the higher weight.

The general belief was that the T-58D would have to deal primarily with single low-manoeuvrability targets flying at altitudes between 2,000 and 24,000 m (6,560-78,740 ft) and speeds up to 2,500 km/h (1,550 mph). Without having a significant advantage in speed the interceptor stood no chance of destroying such targets in pursuit mode; hence high-speed targets were to be intercepted in head-on mode, and both tactics would be used against slower aircraft. The creators of the weapons system intended to maximise its capabilities by automating the intercept procedure insofar as possible. To this end the T-58D was to feature a purpose-built SAU-58 automatic flight control system (*sis**tem**a avtoma**tich**eskovo oopravl**en**iya* – AFCS) including pre-programmed optimum climb profiles. In the course of GCI guidance and the actual intercept the pilot could choose between three control modes – manual, semi-automatic (flight director mode) and fully automatic.

Designated T58D-1, the first prototype of the new interceptor performed its maiden flight on 30th May 1962 with Sukhoi OKB chief test pilot Vladimir S. Il'yushin at the controls. Even at this early stage the customer demanded installation of a new Smerch-AS fire control radar; thus all three advanced interceptors then under development – the MiG-25P, Tu-128 and Su-15 – would share the same radar type. However, this would necessitate a redesign of the T-58D's forward fuselage; also, integration of a new WCS could delay production and service entry for years. Pavel O. Sukhoi, supported by the K-8 missile's designer Matus R. Bisnovat, pushed for a decision to keep the Oryol radar; they succeeded in making their point not only to the industry's top brass but also to the PVO Commander-in-Chief. The Sobol' radar specified originally never materialised; instead the interceptor featured the Oryol-D58 radar, the D standing for *dora**bot**annyy* (modified).

The manufacturer's flight test programme continued until the end of June 1963; in August the T58D-2 was submitted for state acceptance trials. To speed up the process the trials were held in a single stage instead of the usual two. Actually they involved not just the aircraft but the entire aerial intercept weapons system built around it. Designated Su-15-98, the system comprised the Su-15 interceptor powered by two R11F2-300 engines, its Oryol-D58 radar and two modernised K-8M1P air-to-air missiles which received the new designation K-98, alias *izdeliye* 56. The missile came in two versions (IR-homing and radar-homing). The system worked with the Vozdukh-1M GCI system.

The T-58D's combat radius and effective range turned out to be shorter than expected, ferry range with two drop tanks being only 1,260 km (780 miles) instead of the required 2,100 km (1,300 miles). Hence, in the first quarter of 1964 the fuselage was redesigned by eliminating the 'waist' of the area-ruled section. This increased internal fuel capacity to 6,860 litres (1,509 Imp gal) – more than the total pre-modification fuel capacity *with* drop tanks.

On 30th April 1965 the Council of Ministers issued a directive formally including the Su-15-98 aerial intercept weapons system into the inventory under the service designation Su-15; the Oryol-D58 radar was officially designated RP-15, while the K-98 missile was redesignated R-98. The interceptor entered production at the Novosibirsk aircraft factory No.153, replacing the Yak-28P on the assembly line; the Su-15 received the product code *izdeliye* 37. The first pre-production aircraft was rolled out on 21st February 1966. Full-scale production began in mid-1966; production aircraft were powered by R11F2S-300 engines rated at 6,175 kgp (13,610 lbst) in full afterburner. The SAU-58 AFCS took a while to develop, passing its state acceptance trials only in 1968. The trials revealed that the SAU-58 required major changes and it was decided to postpone its introduction until the aircraft's next upgrade. As a result, the aircraft had neither the AFCS nor the simpler AP-28 autopilot fitted to the prototypes; the road to hell is paved with good intentions!

This view of a Su-15 *sans suffixe* shows the characteristically splayed air intakes, the area ruling of the fuselage near them, the two R-98M missiles and the fuselage hardpoints.

The avionics fit of early-production Su-15s included an RSIU-5 (R-802V) VHF communications radio, an MRP-56P marker beacon receiver, an RV-UM low-range radio altimeter, an ARK-10 ADF, SOD-57M distance measuring equipment, a Lazoor' (ARL-S) command link receiver, an SRZO-2M IFF transponder, a Sirena-2 radar warning receiver, a KSI-5 compass system and an AGD-1 artificial horizon. From 1967 onwards new Su-15s were built with the improved RP-15M (Oryol-D58M) radar having higher ECM resistance, while previously built operational examples were upgraded *in situ*.

The Su-15 and its systems underwent constant refinement in the course of production. The biggest number of upgrades was made in Batch 11 in 1969. New double-delta wings and blown flaps were introduced from c/n 1115301 and c/n 1115331 respectively. The double-delta wings had a positive effect on the fighter's stability but caused a slight reduc-

Three-quarters rear view of the Su-15 showing the brake parachute housing and the dorsal afterburner cooling air scoops.

tion in performance at supersonic speeds and a reduction of the service ceiling; however, the performance was still within the limits specified by the military. Also, from c/n 1115336 onwards all Su-15s had provisions for installing the new Tumanskiy R13-300 engines.

Production of the initial Su-15 *sans suffixe* continued until 1971 when it was succeeded by the more advanced Su-15TM. The NATO reporting name was *Flagon-A*.

Sukhoi Su-15UT conversion trainer (U-58T, *izdeliye* 42; *Flagon-C*)

Early project work on a two-seat trainer version of the Su-15 dated back to 1961-62 but had to be suspended due to pressure of higher-priority programmes, resuming in April 1965. The aircraft received the in-house designation U-58 (*oo**cheb**nyy* [*samo**lyot***] – trainer). It differed from the single-seater in having a 450-mm (1 ft 5¾ in) fuselage stretch to accommodate a second cockpit for the instructor and reduced fuel capacity; the cockpits were enclosed by a common canopy similar to that of the Su-9U.

In 1967 the Air Force demanded that the new *Taï**foon*** (Typhoon) fire control radar developed by the LNPO ***Len**inets* (Leninst) avionics house – a derivative of the RP-S Smerch – be integrated on the Su-15. This meant the Taïfoon would have to be fitted to the trainer as well, causing further delays to the programme which was already behind schedule. Hence the OKB suggested a simplified conversion trainer lacking some of the equipment items; these would be added later to create a fully capable combat trainer. The aircraft received the OKB designation U-58T and the service designation Su-15UT (*oo**cheb**no-treni**rov**ochnyy* – for [conversion and proficiency] training). It shared the navigation and communications suite of the single-seat Su-15 but lacked the latter's radar, GCI command link system, radar warning receiver and missile arming/launch system (the Su-15UT could carry only dummy missiles).

The first prototype having pure delta wings made its maiden flight on 26th August 1968. Due to pressure from the Ministry of Aircraft Industry the state acceptance trials began as early as 2nd October, proceeding in parallel with the manufacturer's flight tests. The trials were completed on 26th February 1969. Generally, the Su-15UT was deemed suitable as a pilot trainer – weapons training was beyond its capabilities.

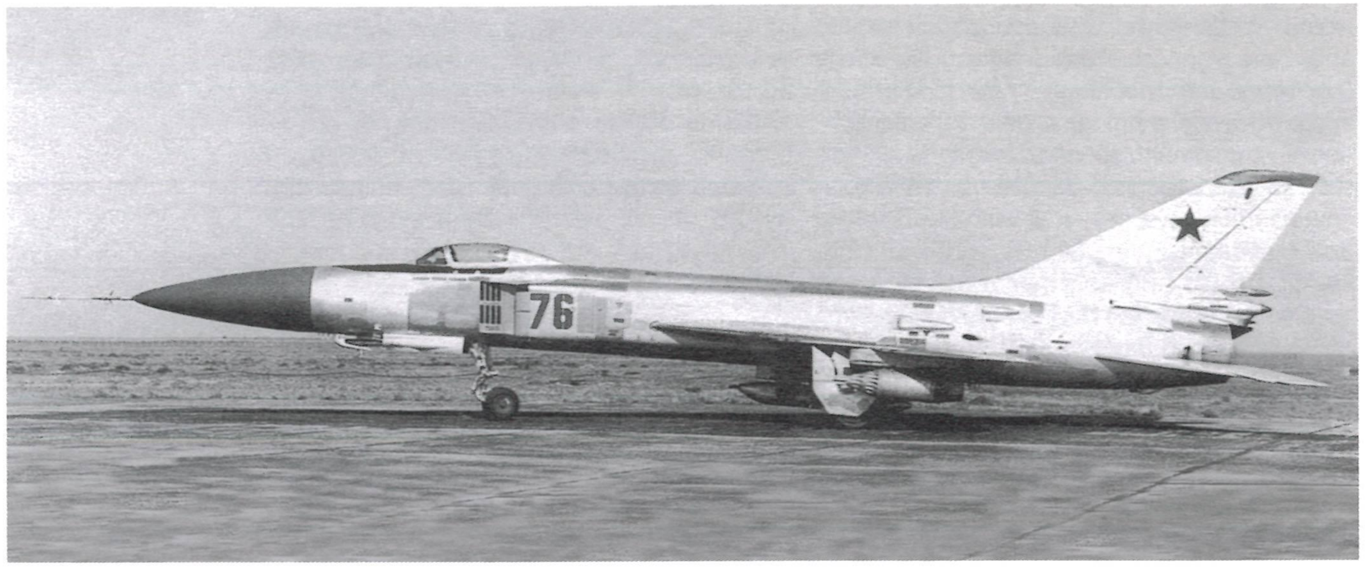
The Su-15UT entered production in 1969 as *izdeliye* 42, remaining in production until the end of 1972. Production examples differed in having double-delta wings and an operational BLC system. The first five Su-15UTs were delivered in the spring of 1970; in July that year the aircraft was officially included into the inventory. The Su-15UT had the NATO reporting name *Flagon-C*.

Sukhoi Su-15T interceptor (T-58T, *izdeliye* 37M, *izdeliye* 38; *Flagon-E*)

The military were not quite happy with the performance of the basic Su-15 *Flagon-A*. An upgrade referred to in contemporary documents as the 'Su-15 Stage II' was developed in due course, on a 'time permitting' basis due to pressure of higher-priority programmes.

Another perspective of a Su-15 *sans suffixe* showing the pure delta wings, the conical radome and the three anti-glare panels.

Two more views of the same aircraft, showing the nose-up ground angle. The orange-painted R-98M missiles are inert test rounds.



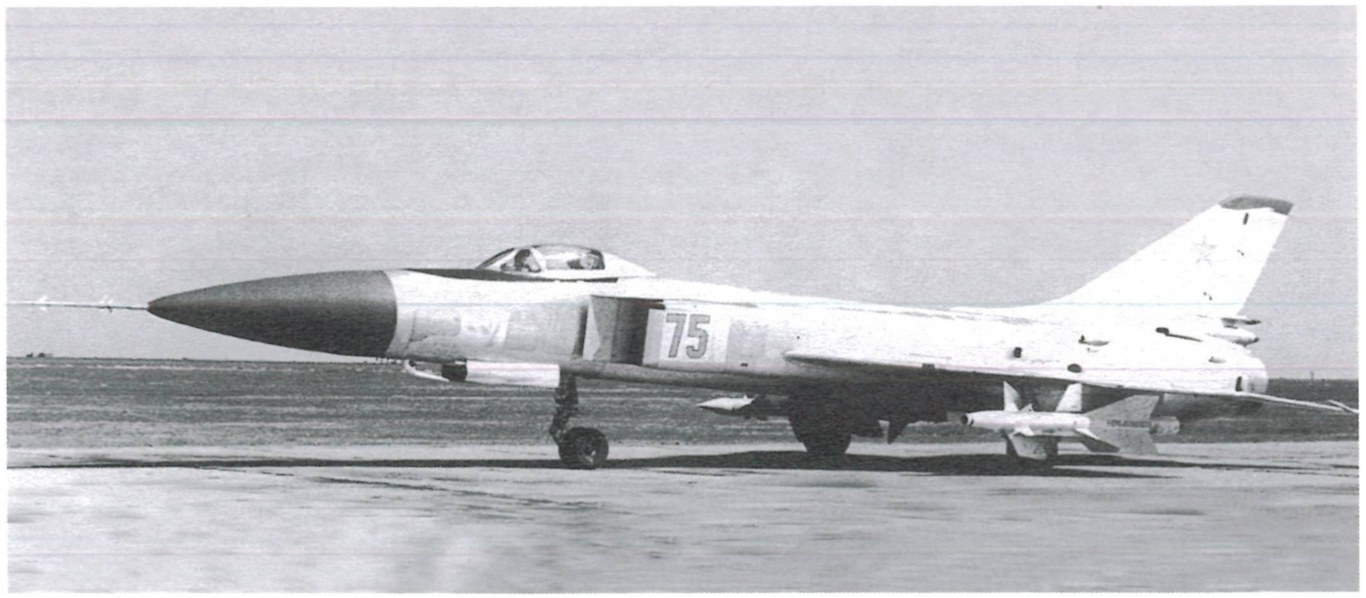
Su-15TM '76 Blue' was used to test the aircraft's suitability for the strike role. Here it is seen carrying UB-32A rocket pods and UPK-23-250 cannon pods.

Actually the work did not begin in earnest until early 1966; the reason was that the type of radar to be fitted was not finalised for a long time.

The ***Kor**shun*-58 (Kite, the bird) fire control radar envisaged originally turned out to be unsuitable. As a result, in October 1967 the Sukhoi OKB was instructed to equip the fighter with the Taïfoon radar.

The upgrade programme was divided into two stages. Stage One involved trials of the aircraft with the existing R-98 AAMs in November 1968; during the second stage slated for the third quarter of 1969 the aircraft was to be armed with the new K-98M missile (which had not yet passed its state acceptance trials either). The aircraft modified to Stage One specifications was designated Su-15T (known in-house as the T-58T), the suffix letter referring to the Taïfoon radar. The new radar was heavier, necessitating the use of a new twin-wheel nose gear unit.

The aircraft was to be powered by new and more powerful Gavrilov R13-300 engines; these had a higher mass flow, requiring the air intakes to be widened. Changes to the hydraulics and electrics were envisaged. The control system was also to be modified by incorporating the servo drives of the SAU-58 AFCS which was approaching the end of its development. Apart from the usual speed/altitude/angle stabilisation and 'panic button' (automatic restoration of straight and level flight) functions, the SAU-58 was to enable automatic low-level terrain-following flight. This feature was not meant for air defence penetration, of course; it resulted from the customer's new requirement that the upgraded Su-15 was to be capable of intercepting targets flying at altitudes right down to 500 m (1,640 ft). Since the Taïfoon radar still lacked 'look-down/shoot-down' capability, the intention was to 'paint' the targets from below, flying at altitudes less than 500 m. The avionics also included an R-832M *Evka**lipt**-SM* (Eucalyptus) radio, an RSBN-5S ***Is**kra-K* (Spark) SHORAN, an ARL-SM (Lazoor'-SM) GCI command link receiver, an ARK-10 ADF, an RV-5 low-range radio altimeter and an SPO-10 Sirena-3 radar homing and warning system.



Su-15TM '75 Blue' shows off the ogival radome and the twin-wheel nose gear unit but the inner wing pylons have yet to be fitted.

The Su-15T made its maiden flight on 27th January 1969. As the military kept pushing the OKB to submit the fighter for state acceptance trials, the manufacturer's tests were suspended after only eight flights. The state acceptance trials of the Su-15T were a far cry from those of the original T-58D, proceeding slowly and laboriously; the main reason was that the Taïfoon radar turned out to be rather troublesome. To avoid delaying the Su-15T's production entry unduly, in February 1970 Stage A of the trials was discontinued. The trials report said that only 63 of the 87 flights made had proceeded in accordance with the plan, the remainder being devoted to perfecting the radar and the AFCS. Stage B of the trials ended in mid-June 1970; it was not completed in full either, as MAP and the Air Force demanded the beginning of the Su-15TM's state acceptance trials pronto. Generally the weapons system met the specifications, even though the new avionics were rather unreliable.

The first production Su-15T made its first flight on 20th December 1970, more than a year behind schedule. The new model was referred to initially as *izdeliye* 37M; later, when the Su-15TM (again designated *izdeliye* 37M) entered production, the Su-15T's product code was changed to *izdeliye* 38 to discern it from the newer model. As the trials of the more advanced Su-15TM progressed, the PVO's interest in the Su-15T waned, and a mere 20 were built. The delivery of these aircraft dragged on for more than a year due to the need to rectify defects; the aircraft did not become operational until the summer of 1972. The Su-15T's NATO reporting name was *Flagon-E*.

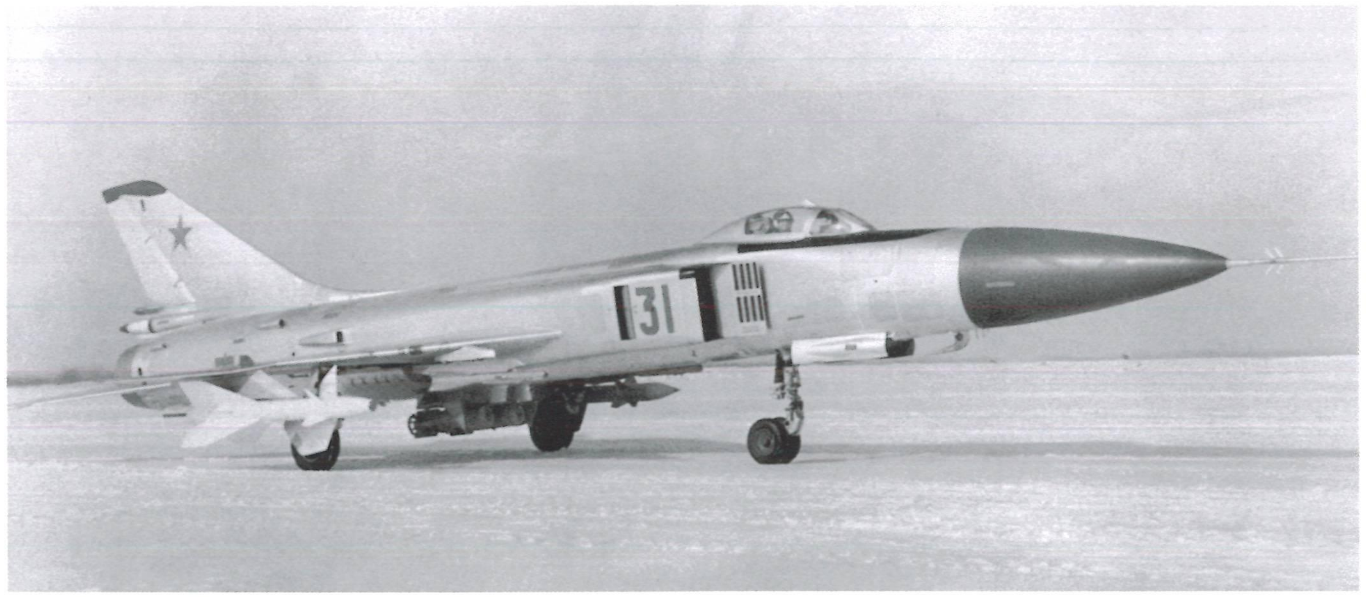
Sukhoi Su-15TM interceptor (T-58TM, *izdeliye* 37M; *Flagon-F*)

As already mentioned, the upgrade programme was divided into two stages. The Stage Two aircraft due to enter test in the third quarter of 1969 was to be armed with the new K-98M missiles and designated Su-15TM as the core of the upgraded Su-15-98M aerial intercept weapons system. This gave the defence industry a respite, allowing the new avionics and armament to be put through their paces.

The second prototype T-58T completed in December 1969, in effect, became the Su-15TM prototype; it featured R13-300 engines and an upgraded Taïfoon-M radar compatible with K-98M missiles. Due to development problems it was not until 7th April 1970 that the Su-15TM prototype first flew with Vladimir A. Krechetov at the controls. The aircraft commenced state acceptance trials in September 1970.

Stage A comprising 40 flights was to verify the operation of the aircraft's principal systems. Progress was terribly slow, even though

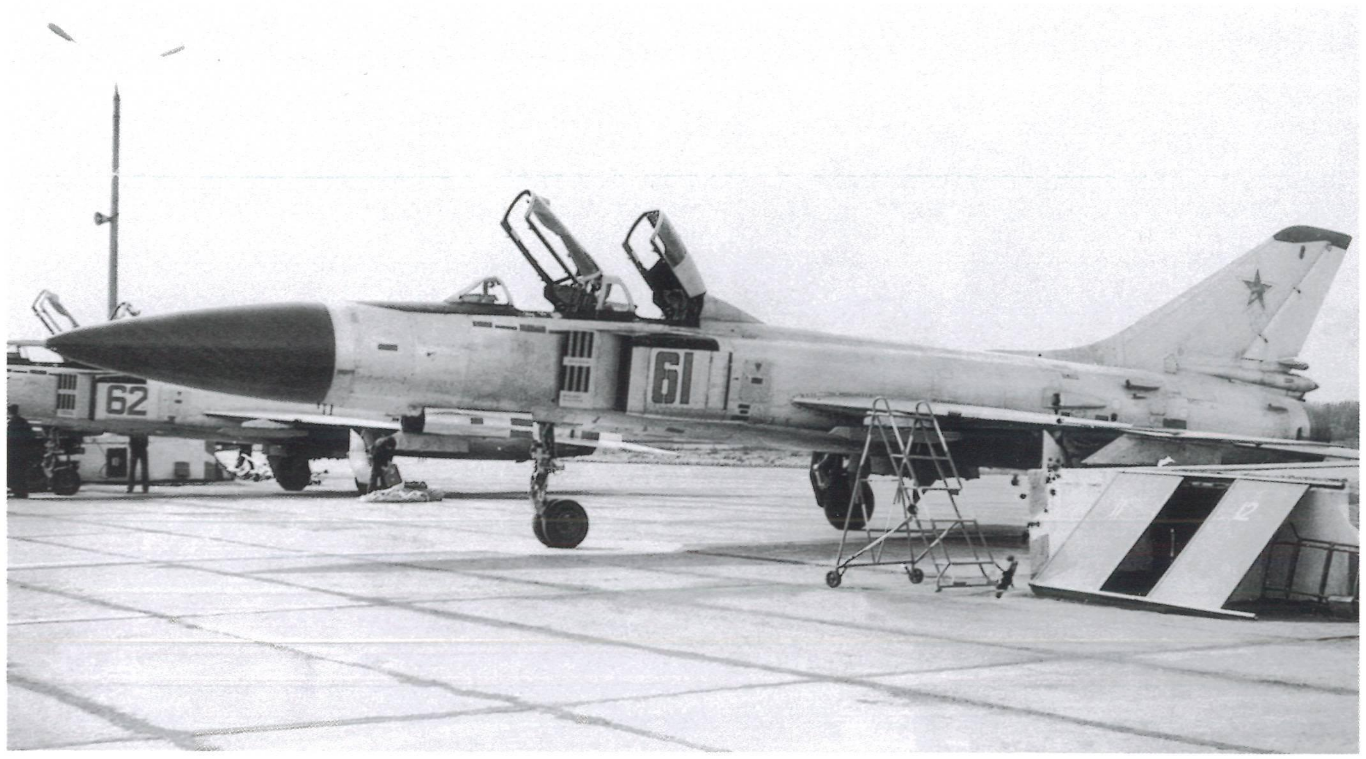
Su-15TM '31 Blue' carries a rather strange mix of orndnance, with two 250-kg (550-lb) high-explosive bombs on the fuselage pylons to complement the R-98MR on the port outer pylon, the R-98MT on the starboard outer pylon and inert R-60s on the inner wing pylons.



Two views of an operational Su-15UM coded '61' with the canopies open. Note the folded blind flying curtains in the trainee's cockpit.

Opposite: The same Su-15UM and sister ship '62' await the next training session at a flight line equipped with a centralised electric power distribution system obviating the need for GPUs. Note the different tactical code presentation on aircraft obviously belonging to the same unit.

four aircraft were involved. Radar operation and the guidance of the radar-homing AAMs at low altitudes was unstable, and the Air Force called a halt to the testing. The state acceptance trials resumed on 26th August after the Taïfoon-M radar had been updated. Stage A ended on 31st March. Nearly all performance targets had been met, with the exception of the weapons system's low-altitude performance. When the results had been analysed, eventually the strengths outweighed the weaknesses and the aircraft was recommended for production. The Su-15TM entered production in October 1971, superseding the



Su-15T; the product code (*izdeliye* 37M) remained unaltered. This was the last of the *Flagon's* production versions, the final Su-15TMs rolling off the Novosibirsk production line in late 1975.

Stage B of the state acceptance trials began on 17th April 1972 and was completed in April 1973. The production radars proved fairly reliable; also, they exhibited higher ECM resistance. At this stage the OKB had to tackle the task of increasing intercept efficiency at low altitudes (initially only 20% of such missions were successful). A new GCI guidance algorithm had to be developed, and the result

'10 Blue', a late-production Su-15TM in service with one of the PVO's first-line units.

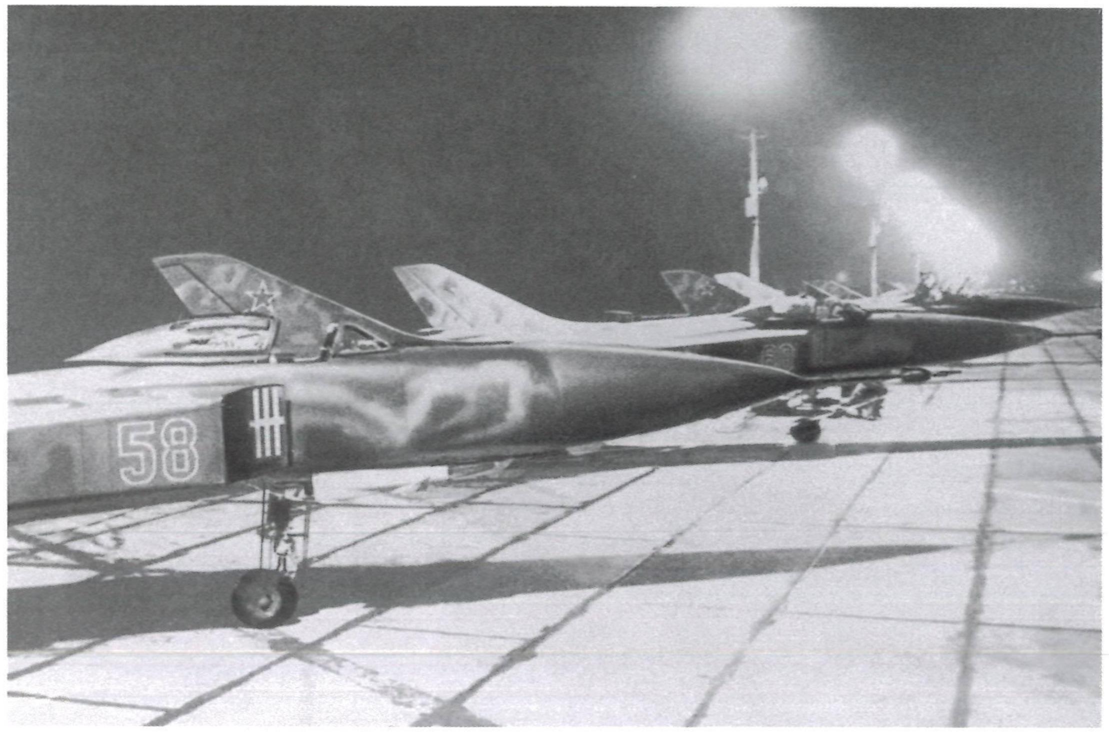
Below: During the mid-1980s some Su-15s (such as this Su-15TM coded '24') gained three-tone camouflage. Pilots were also obliged to perform strike duties.

was felt immediately – the success rate reached 75%.

Deliveries to the PVO began in the spring of 1972. At first, apart from the radar, production Su-15TMs were virtually identical to the Su-15T. Empty weight increased to 10,870 kg (23,960 lb) versus 10,220 kg (22,530 lb) for the Su-15 *sans suffixe*; the fuel capacity was 6,775 litres (1,490.5 Imp gal) and the fuel load 5,550 kg (12,235 lb).

One of the deficiencies the Sukhoi OKB and LNPO Leninets had to rectify together was the clutter on the radar display arising from reflections of the radar pulse inside the conical radome. The avionics house suggested fitting an ogival radome to cure the problem. Tests of such radomes showed that the annoying echoes had vanished but flight performance had deteriorated somewhat because the new radome created more drag. The tests were completed in the autumn of 1973. By then, a considerable number of Su-15TMs had been built with the old 'pencil nose'; the ogival radome was introduced in production from Batch 8 onwards and previously manufactured aircraft were progressively updated in service.

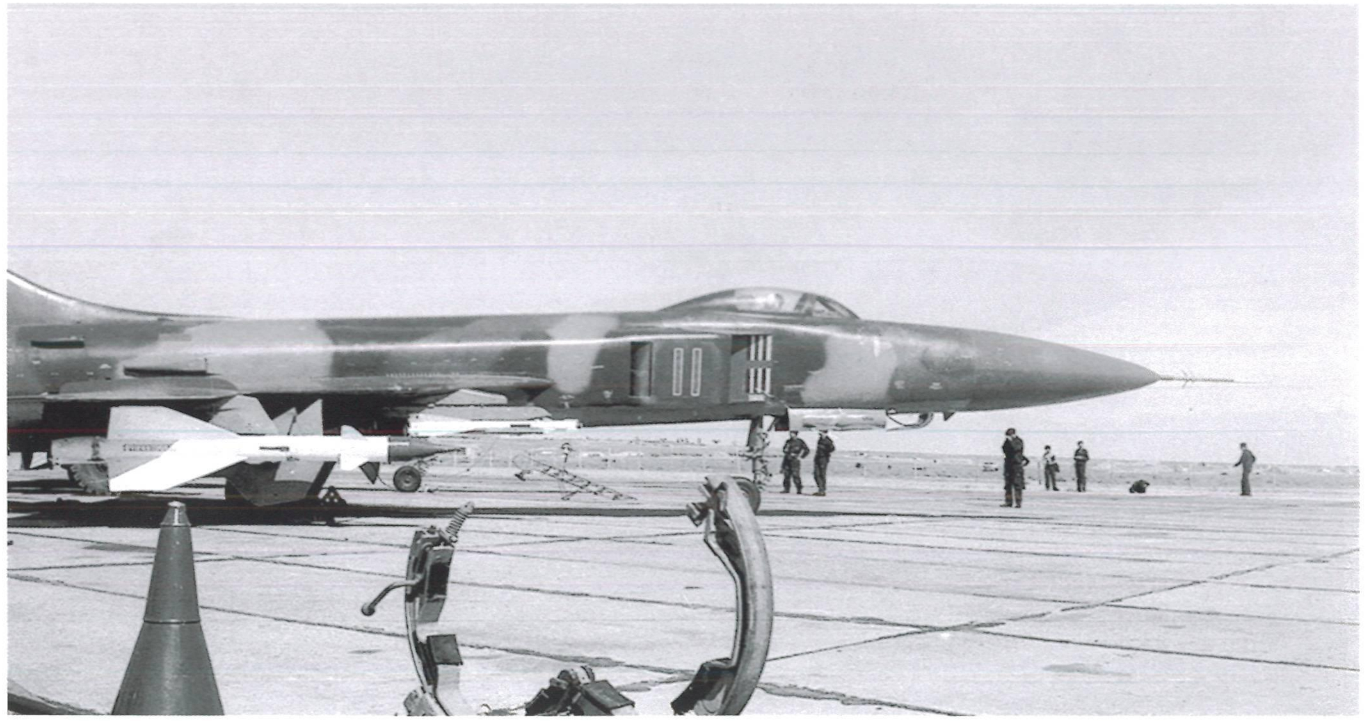
The Su-15-98M weapons system was officially included into the inventory on 21st January 1975. It enabled manually or automatically controlled interception of single targets flying at 500-24,000 m (1,640-78,740 ft) and up to 1,600 km/h (990 mph) in pursuit mode and targets flying at 2,000-21,000 m (6,560-68,900 ft) and up to 2,500 km/h (1,550 mph) in head-on mode. On the down side, the service ceiling had decreased from 18,500 m (60,690 ft) – the figure obtained in the course of the state acceptance trials – to



Opposite: A publicity shot of two Su-15TMs, supposedly on QRA duty, parked right in the middle of the taxiway. The pilots are wearing GSh-6A pressure helmets. Note the MiG-25s in the background.

An atmospheric night shot of the flight line at a unit equipped with Su-15TMs. Aircraft with the low-visibility tactical codes '58 White outline' and '60 White outline' are foremost; the fourth aircraft in the row is a Su-15UM.

Another camouflaged Su-15TM armed with R-98Ms and R-60s. The tactical code is probably '11 Red'.



Two views of a Su-15TM in standard natural metal finish. The *Flagon* was literally covered all over in maintenance stencils.

17,970 m (58,960 ft). After service entry the Taïfoon-M radar received the official designation RP-26, while the K-98M missile was renamed R-98M. The Su-15TM had the NATO reporting name *Flagon-F*.

From Batch 6 onwards the Su-15TM was equipped with the upgraded SAU-58-2 AFCS enabling automatic interception of low-flying targets (which was beyond the capabilities of the earlier SAU-58). The weapons complement was augmented with two R-60 'dogfight missiles', which had passed their trials in late 1974; the new weapon was integrated *in situ* from 1979 onwards. Finally, at the insistence of the military the Taïfoon-M radar was upgraded as part of the measures to offset the damage done by Viktor I. Belenko's defection to Japan in 1976 (see MiG-25P) but its is not known with certainty if operational Su-15TMs were thus upgraded.

Sukhoi interceptor specifications

	Su-9	Su-9U	Su-11	Su-15	Su-15TM	Su-15UT	Su-15UM
Year of service entry	1960	1961	1962	1967	1975	1969	1976
Powerplant	AL-7F-1	AL-7F-1	AL-7F-2	2 x R11F2S-300	2 x R13-300	2 x R11F2S-300	2 x R13-300
Thrust, kgp (lbst):							
dry	6,800 (14,990)	6,800 (14,990)	6,800 (14,990)	2 x 3,900 (8,600)	2 x 4,100 (9,040)	2 x 3,900 (8,600)	2 x 4,100 (9,040)
reheat	9,600 (21,160)	9,600 (21,160)	9,600 (21,160)	2 x 6,200 (13,670)	2 x 6,600 (14,550)	2 x 6,200 (13,670)	2 x 6,600 (14,550)
Length (less pitot)	18.055 m (59 ft 2⅞ in) [1]	18.655 m (61 ft 2½ in) [1]	17.546 m (57 ft 6¾ in)	20.54 m (67 ft 4⅝ in)	20.54 m (67 ft 4⅝ in)	20.99 m (68 ft 10⅜ in)	19.66 m (64 ft 6 in)
Wing span	8.536 m (28 ft 0 in)	8.536 m (28 ft 0 in)	8.536 m (28 ft 0 in)	8.616 m (28 ft 3¼ in)	9.34 m (30 ft 7¾ in)	8.616 m (28 ft 3¼ in)	9.34 m (30 ft 7¾ in)
Height on ground	4.82 m (15 ft 9¾ in)	4.82 m (15 ft 9¾ in)	4.7 m (15 ft 5 in)	5.0 m (16 ft 4⅞ in)	4.843 m (15 ft 10⅝ in)	5.0 m (16 ft 4⅞ in)	4.843 m (15 ft 10⅝ in)
Wing area, m^2 (sq ft)	34.0 (365.5)	34.0 (365.5)	34.0 (365.5)	34.56 (371.6)	36.6 (393.54)	34.56 (371.6)	36.6 (393.54)
Take-off weight, kg (lb):							
normal	11,442 (25,225)	11,773 (25,955)	12,674 (27,940)	16,520 (36,420) [5]	17,194 (37,905) [5]	16,690 (36,795) [9]	17,200 (37,920) [5]
maximum	12,512 (37,583)	12,863 (28,357)	13,986 (30,833)	17,094 (37,685) [4]	17,900 (39,460) [7]	17,200 (37,920) [4]	17,900 (39,460) [7]
Empty weight, kg (lb)	7,675 (16,920)	n.a.	8,562 (18,875)	10,220 (22,530)	10,874 (23,970)	10,750 (23,700)	10,635 (23,445)
Internal fuel, kg (lb)	3,100 (6,835)	3,100 (6,835)	3,440 (7,580)	5,600 (12,345)	5,550 (12,235)	5,010 (11,045)	5,550 (12,235)
Top speed, km/h (mph):							
at sea level	n.a.	n.a.	n.a.	1,200 (745)	1,300 (807)	1,200 (745)	1,250 (776)
at 12,000 m (39,370 ft):							
1-minute afterburner engagement	2,230 (1,385)	2,230 (1,385)	n.a.	2,230 (1,385) [6]	2,230 (1,385) [8]	1,850 (1,150) [6]	1,875 (1,164) [10]
prolonged afterburner engagement	2,120 (1,315) [2]	2,100 (1,304) [3]	2,340 (1,450)	n.a.	n.a.	n.a.	n.a.
Mach number							
at high altitude	n.a.	n.a.	n.a.	2.1 [6]	2.1 [8]	1.75 [5]	1.75 [10]
Service ceiling, m (ft)	20,000 (65,620)	19,700 (64,630)	18,000 (59,050)	18,500 (60,695)	18,500 (60,695)	16,700 (54,790)	15,500 (50,850)
Range, km (miles):							
on internal fuel	1,350 (838)	1,130 (700)	1,260 (780)	1,270 (790)	1,380 (860)	1,290 (800)	n.a.
with drop tanks	1,800 (1,118)	1,370 (850)	1,710 (1,060)	1,550 (960)	1,700 (1,055)	1,700 (1,055)	1,150 (715)
Take-off run, m (ft)	1,200 (3,940)	1,350 (4,430)	1,100-1,250 (3,600-4,100)	1,100 (3,600)	1,000-1,100 (3,280-3,600)	1,200 (3,940)	n.a.
Landing run, m (ft):							
w/o brake parachute	1,150-1,250 (3,770-4,100)	1,200 (3,940)	1,000-1,200 (3,440-3,940)	1,500 (4,920)	1,050-1,150 (3,440-3,770)	n.a.	n.a.
with brake parachute	n.a.	n.a.	n.a.	1,000 (3,280)	850-950 (2,790-3,120)	1,150-1,200 (3,770-3,940)	n.a.
Armament:							
missiles	4 x RS-2-US or 2 x RS-2-US + 2 x R-55	4 x RS-2-US	2 x R-8M	2 x R-98R/T or R-8MR/MT or R-8MR1/MT1	2 x R-98R/T or R-8MR/MT or R-8MR1/MT1	2 x R-8MT or 2 x R-60	2 x R-98MT or 2 x R-60
cannons	–	–	–	2 x UPK-23-250 [11]	2 x UPK-23-250 [11]	–	–

Notes:
1. Including pitot
2. Speed limited to Mach 2.1
3. With two RS-2-US missiles
4. With two drop tanks/no missiles
5. With two R-98 missiles
6. At 15,000 m (49,210 ft)
7. With two drop tanks, two R-98Ms and two R-60s
8. At 13,000 m (42,650 ft)
9. With two dummy R-98 missiles
10. At 11,500 m (37,730 ft)
11. The UPK-23-250 houses a 23-mm GSh-23 twin-barrel cannon with 250 rounds

Sukhoi Su-15UM combat trainer (U-58TM, *izdeliye* 43; *Flagon-G*)

In late 1974 the Sukhoi OKB started work on a combat trainer version of the Su-15TM which bore the manufacturer's designation U-58TM and the service designation

Su-15UM. The trainer was based on the airframe of the late-production Su-15TM; unlike the preceding Su-15UT, there was no fuselage stretch, the overall length being the same as the single-seater's. The twin-wheel nose gear unit was also retained.

Remarkably, the provision of a second cockpit did not incur a reduction of the fuel tankage, the space for it being provided by deleting some equipment items. The internal fuel capacity was 6,775 litres (1,490.5 Imp gal); additionally, two 600-litre (132 Imp gal) drop tanks could be carried. Equally remarkably, the U-58TM's empty weight was lower than the single-seater's. This was accomplished by deleting much of the Su-15TM's avionics, namely the radar, the SAU-58-2 AFCS, the Lazoor'-M command link system, the SPO-10 radar warning receiver and the RSBN-5S SHORAN. The avionics included an R-832M radio, an ARK-10 ADF, an RV-5 low-range radio altimeter, an MRP-56P marker beacon receiver, a KSI-5 compass system and an AGD-1 artificial horizon. In order to retain a measure of combat capability so that weapons training could be performed, the U-58TM could carry IR-homing missiles – the medium-range R-98T and the short-range R-60. Additionally, UPK-23-250 cannon pods could be carried on the fuselage hardpoints.

The maiden flight took place on 23rd April 1976 with factory test pilots V. T. Vylomov and V. A. Belyanin at the controls. On 23rd June the Su-15UM was turned over for state acceptance trials; these were completed on 25th November with good results. The Novosibirsk aircraft factory produced the new trainer in 1976-81 under the product code *izdeliye* 43. The Su-15UM's NATO reporting name was *Flagon-G*.

Sukhoi Su-27P interceptor (T-10P, *Flanker-B*)

Back in the late 1960s the Sukhoi OKB had started work on the Su-27 fourth-generation fighter known in-house as the T-10. The aircraft featured a so-called blended wing/body (BWB) layout in which the wings and fuselage formed a single lifting body with wing leading-edge root extensions (LERXes) of complex shape. This layout offered major advantages over the traditional one both from a structural design standpoint (making for a strong and light structure in which the internal volume was used rationally) and as regards aerodynamics; at high angles of attack the LERXes generated powerful vortices, improving the lift/drag ratio and enhancing manoeuvrability. The centre of gravity (CG) was located well aft, making the aircraft statically unstable in the pitch channel and thus enhancing manoeuvrability. Also, the T-10 was the first Soviet aircraft to feature, in planned production form, an automated fly-by-wire (FBW) control system with no direct mechanical link between the stick and pedals and the control surfaces.

The original T-10 *sans suffixe* (NATO reporting name *Flanker-A*) first flew on 20th May 1977. Yet, even at the prototype construction stage it became clear that the initial aerodynamic layout was a lemon. Tests of the T10-1 and T10-3 prototypes showed that the fighter did not meet the performance target stipulated by the Council of Ministers directive. Sukhoi OKB designers were aware that there was no simple remedy, such as increasing the fuel capacity to increase range; more drastic measures were needed. Realising they had ended up with a substandard fighter that could not match the performance of the best western fighters, the designers took the brave decision to throw away eight years of work and start from scratch. Considering the end result, this was the only correct approach.

The Siberian Aviation Research Institute (SibNIA – *Si**beer**skiy na**ooch**no-is**sle**dovatel'skiy insti**toot** avi**ah**tsii*) in Novosibirsk, a fairly authoritative organisation in the field of aerodynamics, had been involved in the T-10 programme since 1972 but the institute's advice had been largely ignored – probably due to the OKB leaders' reluctance to make any changes to the project, and there was hell to pay. Now was the time to listen.

While the basic features of the T-10 (the BWB layout with twin tails and spaced underslung engine nacelles, the Lyul'ka AL-31F afterburning turbofans and the FBW controls) were retained, the aerodynamics needed a complete rework. Virtually every aspect of the fighter's general arrangement – the wing planform, the shape and position of the tail surfaces – became a subject of criticism. Faced with the task of increasing the pitch-down force during manoeuvres in order to enable recovery from extremely high AoAs, SibNIA proposed recontouring the wings and increasing wing area aft of the CG. To delay airflow departure the wings were provided with adaptive leading-edge and trailing-edge devices governed by the FBW control system. The vertical tails were placed as far apart as possible (outboard of the engine nacelles) and the sta-

A Su-27P carrying a full complement of six inert R-27 medium-range AAMs and four R-73 short-range AAMs.

This Su-27P has its typical weapons arrayed in front of it. The centre pair is the R-27T IR-homing version, the left and right ones are radar-homing R-27Rs; note the safety covers on the rudders. The centre dolly holds enough R-73s to serve two aircraft (the Su-27 never carried eight R-73s at a time).

bilators were moved aft; this improved the efficiency of both the vertical and horizontal tail. The fuselage cross-section was reduced in the cockpit area but increased aft of the cockpit where the forward fuel tank was located. The aft fuselage was redesigned, the flat 'beaver tail' of the *Flanker-A* giving place to a distinctive circular-section 'stinger' which housed the brake parachute container and the aft fuel tank. These measures were aimed at cutting drag. A new single dorsal airbrake located aft of the cockpit was introduced.

The airframe was fairly lightweight, utilising new high-strength titanium and aluminium alloys and state-of-the-art manufacturing technologies (including some 'world firsts', such as automatic arc-welding in a liquid medium), and was stressed for +9 Gs. In short, the resulting aircraft bore only a remote resemblance to its predecessor.

The design stage was finally completed in 1980; the resulting aircraft was designated T-10S (*se**reey**nyy* – production, used attributively). The first prototype T-10S (designated T10-7) was completed in late 1980; it took to the air on 20th April 1981, joining the state acceptance trials programme soon afterwards. Thus the Su-27 as we know it was finally born.

The Su-27's WCS was built around the N001 Mech (Sword; NATO *Slot Back*) coherent pulse-Doppler fire control radar developed by the Moscow Institute of Instrument Engineering named after Viktor V. Tikhomirov (NIIP) with assistance from NPO Phazotron, another renowned avionics house. The N001 gave the desired 'look-down/shoot-down' capability, detecting and tracking up to ten targets below the fighter's own flight level, assigning the two top priority threats among the targets and guiding AAMs to them, even in an ECM environment. The radar continuously tracked the target marked for termination and illuminated it for the missile's SARH seeker head. It could also detect and track ECM sources and feed target data to the opto-electronic targeting system. Detection range for a target with a radar cross-section (RCS) of 3 m² (32.25 sq ft) was 80-100 km (49-62 miles) in head-on mode and 30-40 km (18.6-24.8 miles) in pursuit mode.

The OEPS-27 optoelectronic sighting system (***op**tiko-elek**tron**naya pri**tsel'**naya sis**tem**a*) featured an infrared search & track/laser rangefinder unit (IRST/LR) with day and night channels, enabling the aircraft to attack without using the radar and revealing itself. The system was linked to an NSTs-27 helmet-mounted sight (*na**shlem**naya sis**tem**a **tse**leooka**zah**niya*) enabling the pilot to 'point' the missile seeker heads and IRST/LR towards the target simply by turning his head.

The Su-27 had ten weapons pylons under the wings, engine nacelles and fuselage. The missile armament comprised up to six R-27ER1 (or R-27ERE) medium-range AAMs with SARH guidance and/or R-27ET1 (R-27ETE) IR-homing AAMs, or up to six R-73 (R-73E) short-range IR-homing AAMs. The R-73 could destroy extremely agile targets pulling 12 Gs during evasive manoeuvres. A typical ordnance load consisted of two R-73 'dogfight missiles', four R-27ERs and two R-27ET's (option A), or four R-73s (R-73Es), four R-27ERs and two R-27ET's (option B).

For close-in engagements the aircraft was armed with a 30-mm (1.18 calibre) Gryazev/Shipunov GSh-301 cannon in the starboard LERX. The GSh-301 was a dedicated fighter weapon with a 1,600-rpm rate of fire; the ammunition capacity was 150 rounds.

Standard ECM equipment comprised the SPO-15 Beryoza (Birch) radar homing and warning system (RHAWS) with 360° coverage and APP-50 chaff/flare dispensers (*avtomaht passivnykh pomekh*) which could be used for infra-red countermeasures (IRCM) or passive ECM. Additionally, Sorbtsiya-S (Absorption) jammer pods could be fitted to the wingtips, supplanting the outermost missile rails.

To speed up the trials, the Komsomol'sk-on-Amur Aircraft Production Association (KnAAPO – *Komso**mol'**skoye-na-A**moo**re avi-atsi**on**noye proiz**vod**stvennoye obyedi**nen**iye*), began preparing for production even as the flight tests progressed. The first KnAAPO-built T-10S – the T10-12 (aka T10S-2) – was completed in March 1981; this aircraft featured a representative fire control system. State acceptance trials began that same year.

Stage A of the trials was successfully completed on 21st August 1983. Stage B of the trials involving production-standard aircraft began in the second half of 1983; it included verification of the mission avionics suite as a whole and live weapons trials. The state acceptance trials were largely completed in 1985; in the summer of that year the aircraft achieved initial operational capability (IOC) with the PVO. On 23rd August 1990 the Council of Ministers passed a directive officially including the Su-27 into the Air Force and PVO inventory. In its production

A pilot wearing a ZSh-5 helmet climbs into an early green-nosed Su-27P.

'Toad's eye view' of a Su-27UB. The open canopy shows the folded blind flying hood over the front seat.

form the Su-27 was codenamed *Flanker-B* by NATO.

Late-production Su-27s featured an upgraded N001 radar capable of guiding AAMs to two targets at a time (early aircraft could only take on one target at a time). Two pylons were added under the outer wings, increasing the number of hardpoints to 12 and the ordnance load from 6,000 kg (13,230 lb) to 8,000 kg (17,640 lb); this necessitated a reinforcement of the main gear oleos to cater for a TOW increased to 33,000 kg (72,750 lb). To enhance defensive capability the tail 'stinger' was modified to house additional APP-50 chaff/flare dispensers, bringing the total number of flares to 96.

Here it should be mentioned that production Su-27s (at least the Air Force machines) had a secondary strike role. However, in the mid-1980s the Soviet government decided to reduce the Air Force's overall offensive capability, trying to convince the West that the new Soviet military doctrine was 'purely defensive'. To this end the PVO's Su-27s were stripped of strike capability by deleting the avionics associated with air-to-surface weapons delivery, becoming 'pure' fighters. Such aircraft were designated Su-27P (*pere**khvat**chik* – interceptor).

The 'pure' fighter version was built new for the PVO from 1989; the PVO's existing Su-27s were progressively modified to this standard. The Su-27P featured a *Biryu**za*** (Turquoise) command link system enabling GCI centres to direct the aircraft to the target. For the first time on a Soviet combat aircraft a united communications suite was installed, facilitating concerted action by groups of aircraft and automatically transmitting flight data to GCI centres.

Sukhoi Su-27UB combat trainer (T-10U, *Flanker-C*)

A trainer version of the T-10S was developed in parallel. The Sukhoi OKB chose to develop a dual-role aircraft retaining the combat capabilities of the single-seater. Hence the aircraft was designated Su-27UB (*oo**cheb**no-boye**voy*** [*samo**lyot***] – combat-capable trainer); the in-house designation was T-10U.

The main requirements were to ensure maximum commonality with the fighter version and keep the trainer's performance as close as possible to that of the single-seater. The Su-27UB was intended for conversion training in pilot schools, proficiency training of service pilots in VMC and IMC, and aerial intercept duties. 40% of the fuselage structure ahead of the wings was new. The trainee and instructor sat in a stepped-tandem arrangement under a common aft-hinged canopy; the raised rear seat gave the instructor a fairly good view forwards/downwards. The airbrake was reshaped to fit the altered fuselage contour and slightly enlarged. To compensate for the added side area ahead of the CG the fins were made taller by inserting a 420-mm (1 ft 4 17/32 in) plug at the root increasing the area of each fin by 20%. Otherwise the trainer was dimensionally identical to the single-seater.

The avionics suite was identical to the *Flanker-B*'s. All-up weight rose by 1,500 kg (3,310 lb); remarkably, internal fuel capacity was not affected.

The first prototype took to the air on 7th March 1985. The Su-27UB successfully passed the manufacturer's flight tests and state acceptance trials in 1986 and was cleared for production. The first few production aircraft were built by KnAAPO; soon, however, production was assigned to the Irkutsk Aircraft Production Association (IAPO – *Ir**koot**skoye aviatsi**on**noye proiz**vod**stvennoye obyedi**nen**iye*). The first Irkutsk-built Su-27UB took off on 10th September 1986. The trainer was supplied to the Air Force and the PVO alike. The NATO reporting name was *Flanker-C*.

Yakovlev Yak-25 patrol interceptor (*Flashlight-A*)

In 1951 OKB-115 led by Aleksandr S. Yakovlev began development of a two-seat twin-engined patrol interceptor bearing the in-house designation Yak-120; the project was officially sanctioned by Council of Ministers directive No.2929-1379 issued on 10th August 1951. In a marked departure from previous Yakovlev OKB practice, the aircraft had thin mid-set wings swept back 45° and featuring large two-section flaps; the sharply swept cruciform tail surfaces were augmented by a ventral fin for greater directional stability, and two Mikulin AM-5 axial-flow turbojets were mounted in nacelles adhering directly to the wing undersurface. The chosen layout, together with the designers' wish to maximise fuel capacity and endurance, dictated the use of a bicycle undercarriage with a single-wheel nose unit, a twin-wheel main unit and outrigger struts mounted under the wingtips. For added endurance a conformal drop tank could be carried on the fuselage centreline.

An RP-6 Sokol radar was installed in the nose, the huge antenna dish being enclosed by a bullet-shaped glassfibre radome. The crew of two (pilot and radar intercept operator) sat in tandem under a common aft-sliding canopy. The RIO would handle target search and help the pilot guide the aircraft towards the target in adverse weather; also, he could fly the aircraft if necessary, reducing pilot fatigue on long missions (the Yak-120 had dual controls). The fixed windshield incorporated a bulletproof glass panel 105 mm (4 1/8 in) thick; protection was also provided by all-round armour plates 10 mm (0 25/64 in) thick.

The armament comprised two 37-mm (1.45 calibre) Nudel'man N-37L cannons mounted low on the centre fuselage sides. Normal ammo supply was 50 rpg, yet the ammo boxes could hold twice as much. There was also provision for two 212-mm (8.35-in.) ARS-212 unguided rockets under the wings.

The Yak-120's avionics suite enabled it to navigate and intercept its targets in any weather conditions at altitudes right up to the aircraft's service ceiling. Apart from the radar, it included an SRO-1 IFF transponder, an RSIU-3 Klyon VHF radio and an AP-28 autopilot. For automatic landing approach in poor weather the interceptor was equipped with a

Su-27 specifications

	Su-27P	Su-27UB
Year of service entry	1982	1986
Powerplant	2 x AL-31F	2 x AL-31F
Thrust, kgp (lbst):		
dry	2 x 7,850 (17,305)	2 x 7,850 (17,305)
reheat	2 x 12,500 (2 x 27,560)	2 x 12,500 (2 x 27,560)
Length less pitot boom	21.935 m (71 ft 11 39/64 in)	21.935 m (71 ft 11 39/64 in)
Height on ground	5.932 m (19 ft 5 35/64 in)	6.357 m (20 ft 10 17/64 in)
Wing span	14.698 m (48 ft 2 21/32 in)	14.698 m (48 ft 2 21/32 in)
Wing area, m^2 (sq ft)	62.04 (667.06)	62.04 (667.06)
Operating empty weight, kg (lb)	16,000-16,300 (35,270-35,930)	17,500 (38,580)
Normal take-off weight, kg (lb)	22,500 (49,600)	24,000 (52,910) [1]
Maximum TOW, kg (lb)	30,000 (66,140)	30,500 (67,240)
Internal fuel load, kg (lb)	9,400 (20,720)	9,400 (20,720)
Ordnance load, kg (lb)	6,000 (13,230)	4,000 (8,820)
Top speed, km/h (mph):		
at sea level	1,380 (857)	n.a.
at 11,000 m (36,090 ft)	2,500 (1,552)	2,125 (1,320)
Maximum Mach number	2.35	2.0
Service ceiling, m (ft)	18,500 (60,695)	17,250 (56,590)
G limit	9	9
Range with maximum fuel, km (miles):		
at sea level	1,400 (869)	1,300 (807)
at 11,000 m (36,090 ft)	3,900 (2,422)	3,000 (1,863)
Combat radius, km (miles):		
at sea level	440 (273)	n.a.
at altitude	1,380 (857)	n.a.
'Kill' altitude, m (ft)	20-27,000 (65-88,580)	n.a.
Target speed (kill possible), km/h (mph):		
head-on mode	210-3,100 (130-1,925)	n.a.
pursuit mode	210-2,400 (130-1,490)	n.a.
Take-off run, m (ft)	650-700 (2,130-2,300)	750-800 (2,460-2,620)
Landing run, m (ft)	620-700 (2,030-2,300)	650-700 (2,130-2,300)
Armament:		
cannon	1 x GSh-301, 30 mm (1.18 calibre) 150 rounds	1 x GSh-301, 30 mm (1.18 calibre) 150 rounds
missiles	8 x R-27ER/R-27ET 2 x R-73	8 x R-27ER/R-27ET 2 x R-73

Note: 1. With 5,150 kg (11,350 lb) of fuel

Materik (Continent) ILS. Other avionics items included a Pozitron-1 system (which was probably a command link system).

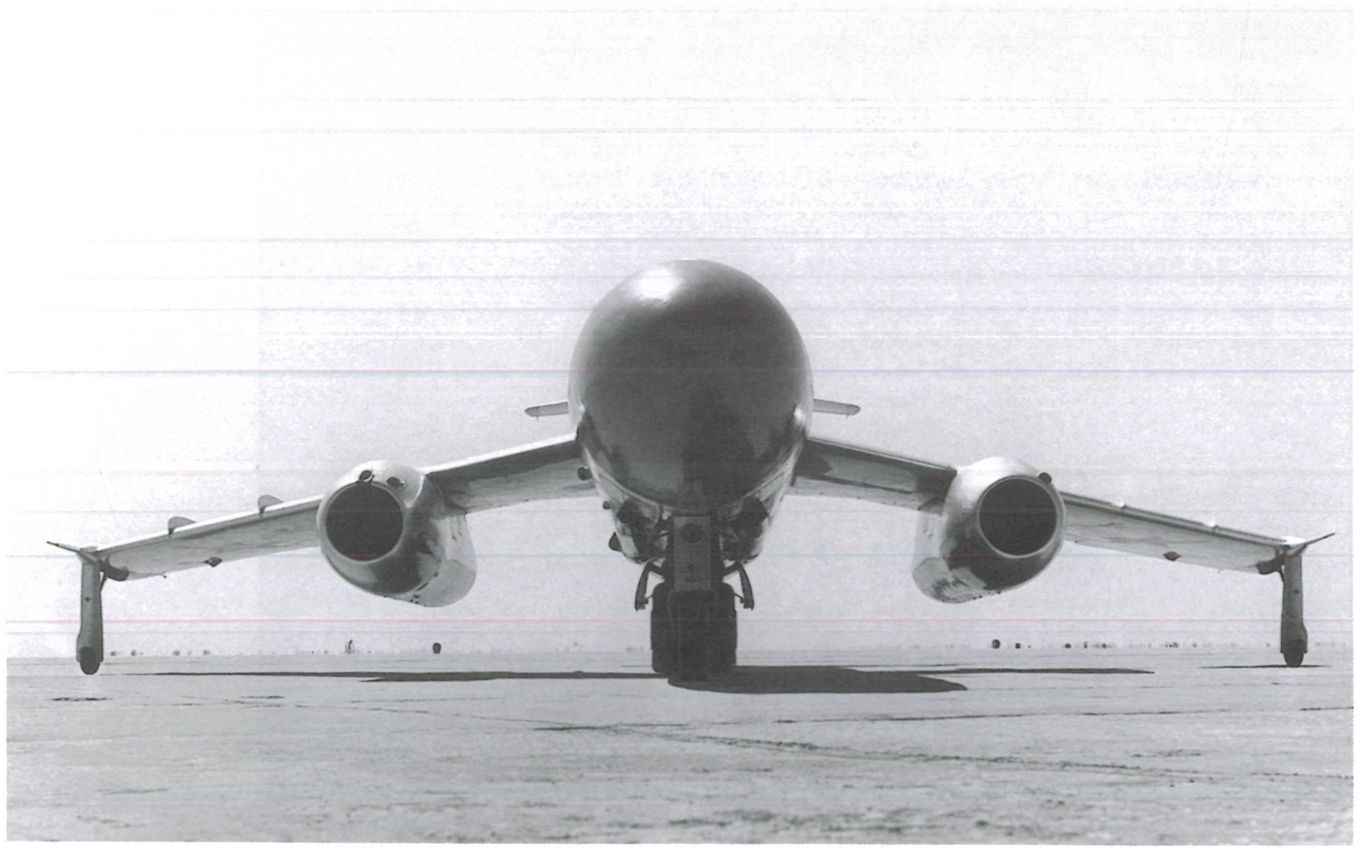
The wings, tail unit and air intakes had hot air de-icing, while the engines' foreign object damage protection screens and intake centrebodies were electrically de-iced. This enabled the Yak-120 to loiter for an extended time at high altitudes with low ambient temperatures and operate in cold climatic regions.

It should be noted that, despite the complex and heavy avionics, the Yak-120 had a lightweight airframe for a twin-engined fighter. The designers had taken great care to minimise structural weight; as a result, airframe weight made up only 29% of the MTOW – the absolute minimum for an all-metal swept-wing combat aircraft. The normal all-up weight (AUW) was 8,530 kg (18,805 lb).

On 19th June 1952 the Yak-120 took to the air for the first time with OKB test pilot Valentin M. Volkov at the controls. The manufacturer's flight tests proceeded until November. The aircraft surpassed the Air Force's specific operational requirement in all respects except range and endurance. With a 7,650-kg (16,865-lb) AUW the Yak-120 had a maximum speed of 1,140 km/h (708 mph) at 4,000 m (13,120 ft) and 1,075 km/h (667 mph) at 10,000 m (32,810 ft). The interceptor climbed to 10,000 m in 4.3 minutes and the service ceiling was 300 m (980 ft) better than specified. Range fell a little short of the requirements; at 12,000 m (39,370 ft) it was 2,800 km (1,740 miles) on internal fuel only and 3,250 km (2,020 miles) with a drop tank. Endurance was 3 hours 45 minutes in 'clean' condition and 4 hours 15 minutes with a drop tank. Still, this did enable the Yak-120 to patrol an assigned area at a considerable distance from its home base.

However, development of the RP-6 radar was facing delays, which meant the Yak-120 could not be submitted for state acceptance trials. Hence in early December 1952 MAP it was decided to fit the production RP-1 Izumrood radar as a temporary substitute; this was easily done, as the huge radome accommodated the twin antennas of the RP-1 without any trouble. From March to June 1953 the Yak-120 was tested at NII VVS with the provisional radar. The results were generally positive and the aircraft was cleared for production in 'as-was' condition under the service designation Yak-25 (which had been used earlier for a single-engined single-seat fighter prototype flown in 1947) pending availability of the RP-6. The test results obtained at NII VVS were approved on 8th September 1953 by Council of Ministers directive No.2359-965 as a specification for Yak-25s.

Production took place at factory No.292 in Saratov in southern Russia; the first Yak-25s were completed in September 1954. The production version's radar incorporated minor changes and was designated RP-1D (*dora**b**otannyy* – improved).



Front view of a Yak-25M.

Yakovlev Yak-25M interceptor (*izdeliye* 12/15; *Flashlight-A*)

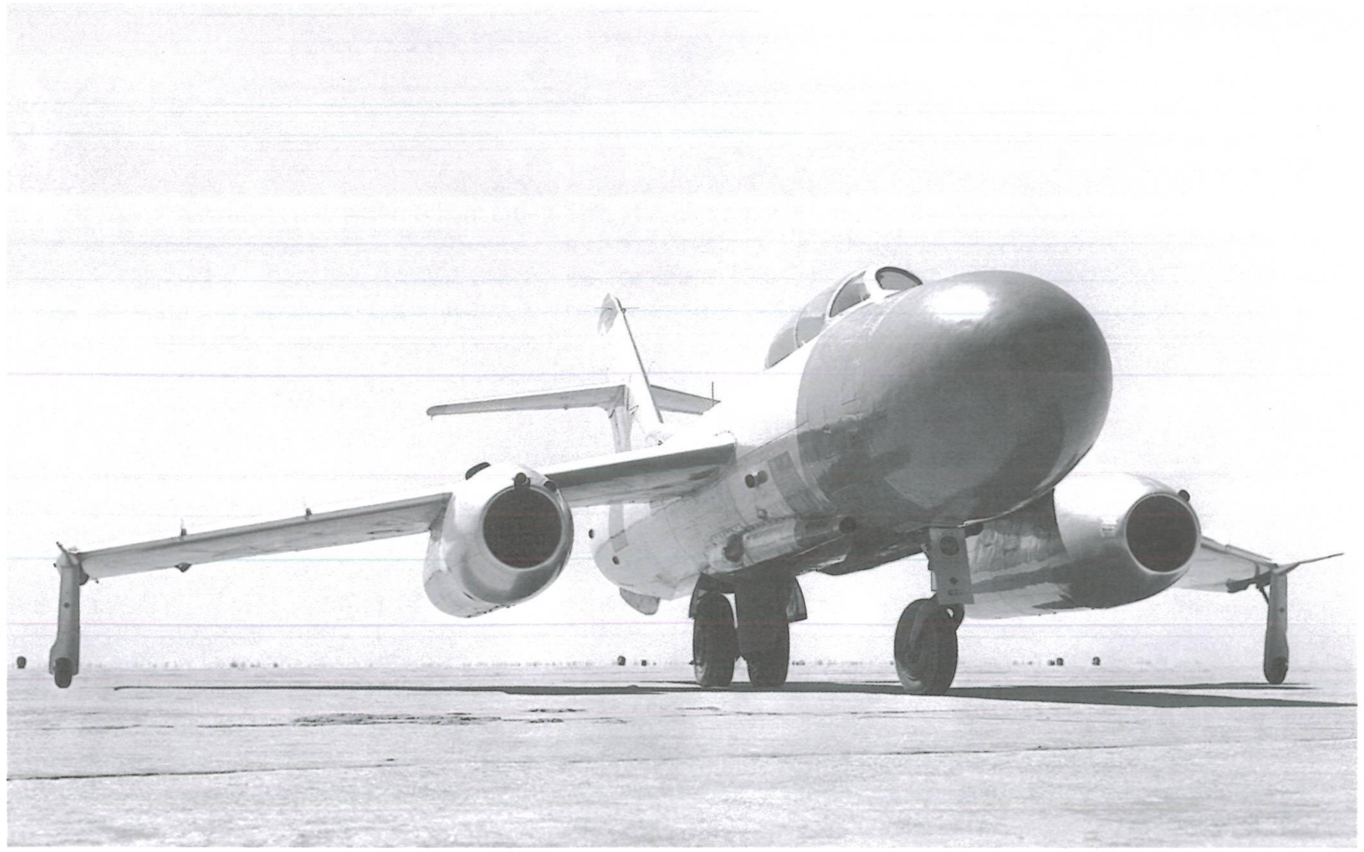
Very few Yak-25s were built to the original standard. By the end of 1953 the RP-6 radar had been brought up to scratch, and in April 1954 the upgraded Yak-120 prototype with this radar successfully completed state acceptance trials. On 13th May 1954 the Council of Ministers issued directive No.899-385 ordering the new version into production as the Yak-25M (*modifi**tsee**rovannyy* – modified). In service, however, this designation did not find wide use; Air Force documents usually refer to production aircraft simply as 'Yak-25', regardless of radar type.

Apart from the radar, the Yak-25M had a number of detail changes. The AM-5A Srs 1 turbojets were replaced with identically rated RD-5A (AM-5A) Srs 2 engines. In order to improve directional stability during take-off and landing the wheelbase was increased by moving the nose gear unit forward 33 cm (1 ft 1 in). The cannons were fitted with muzzle brakes and some other changes were made. The product code at the Saratov aircraft factory was '*izdeliye* 12/15'. A total of 406 aircraft was built to Yak-25M standard.

The Yak-25M's specifications were as follows: normal take-off weight 9,080 kg (20,020 lb); top speed 1,090 km/h (589 kts) at 5,000 m (16,400 ft) and 1,024 m (553 kts) at 10,000 m (32,810 ft); climb time to 10,000 m, 6.1 minutes; service ceiling 14,100 m (46,260 ft); range at 12,000 m (39,370 ft), 2,010 km (1,250 miles) 'clean' and 2,630 km (1,630 miles) with drop tank; endurance at 12,000 m, 2 hrs 48 min and 3 hrs 36 min respectively.

Originally the Yak-25/Yak-25M had the NATO reporting name *Flashlight*. Later, when supersonic derivatives of the aircraft (the Yak-26-1 and Yak-27) became known to the West, this was changed to *Flashlight-A*.

Curiously, the aircraft was never officially included into the IA PVO inventory. Still, this did not prevent the Yak-25 and Yak-25M from soldiering on with the Air Defence Force until the early 1960s. the Yak-25 proved a valuable asset in the remote northern and eastern regions of the USSR. Having twin-engine reliability and a second crew member who could



Another view of the same aircraft showing the fairings of the N-37L cannons. Note the high-gloss finish.

take over the controls gave the pilot extra confidence on long missions.

Yakovlev Yak-25MG interceptor

In the course of their service career some Yak-25Ms were retrofitted with the new *Gra**nat*** radar (the name can be interpreted as either 'Grenadine' or 'Pomegranate'). These upgraded aircraft were sometimes referred to as the Yak-25MG.

Yakovlev Yak-28P interceptor (*izdeliye* 40, *Firebar*)

The Yak-25 became the progenitor of a whole family of tactical twinjets sharing the same general arrangement (more or less). The interceptor role was not forgotten, too. First, the subsonic *Flashlight-A* evolved into the supersonic Yak-27 *Flashlight-C* interceptor and its missile-toting version, the Yak-27K. Design flaws prevented the aircraft from entering production and service with the IA PVO. However, the slightly larger, high-wing Yak-129 tactical bomber (known as the Yak-28 *Brewer* in production form), on which some of the *Flashlight-C*'s shortcomings had been eliminated, entered flight test in 1958, serving with the Soviet Air Force in several versions. It was only logical that an interceptor version should re-emerge at a new performance level.

Thus in 1960 the Yakovlev OKB brought out an all-weather interceptor derivative of the *Brewer* designated Yak-28P (*pere**khvat**chik* – interceptor). It was designed to seek and destroy enemy aircraft at low and medium altitude, day or night, within a wide speed envelope. The Yak-28P featured the K-8M-1 weapons system comprising two R-8M-1 medium-range AAMs on underwing launch rails and the Oryol-D fire control radar developed by OKB-339. The R-8M-1 was an improved version of the K-8 AAM used on the Yak-27K. It came in IR-homing and SARH versions; the idea was to carry one missile of each version and fire them in a salvo for maximum 'kill' probability, should the target use ECM. No cannons were fitted.

As compared to the Su-9 interceptor the Yak-28P had a more sophisticated weapons system. Not only did the Oryol-D have greater detection and tracking range than the Su-9's RP-9 radar but the R-8M-1 also had longer range than the RS-2-US AAMs of the *Fishpot-B*. Moreover, later the aircraft was to receive the K-98 weapons system which was an advanced version of the K-8M-1.

As distinct from the *Brewer*, which had a glazed nose for the navigator and a single-seat cockpit for the pilot, the Yak-28P's cockpit was patterned on that of the Yak-25 and Yak-27K: the pilot and the WSO sat in tandem under a common sliding canopy. Unlike the *Flashlight-C*, the missiles were carried outboard of the engines rather than inboard. Apart from the radar and the Lazoor' GCI command link system, the avionics were identical to those of the Yak-28's bomber versions.

The Yak-28P prototype entered flight test with Tumanskiy R11AF-300 afterburning turbojets in nacelles with elliptical air intakes *à la* Yak-28-2 and Yak-28U. However, compressor stall was experienced during tests; the engineers tried to cure the problem by redesigning the intake shock cones but this was of little help. Eventually the engines were replaced by R11AF2-300s with enlarged circular intakes, just as had been the case with the bomber variants. Since the missile pylons under the outer wings precluded the use of drop tanks, all fuel was carried internally; by using the former bomb bay the Yak-28P's internal fuel capacity was increased by nearly 2,000 litres (440 Imp gal) over the *Brewer*, equalling 6,570 litres (1,445.4 Imp gal).

In 1962 the Yak-28P entered production at the Novosibirsk aircraft factory No.153 with the product code *izdeliye* 40. This was the most prolific version of the Yak-28 family: 435 examples were built up to 1967.

State acceptance trials continued until 1965 with the new engines and K-98 missiles. Still, the aircraft was never officially included into the PVO inventory, despite staying in service for many years. The fighter received the NATO reporting name *Firebar*.

At 12,500 m (41,010 ft) the Yak-28P had a top speed of 1,840 km/h (994 kts) with two AAMs or 2,060 km/h (1,113 kts) in 'clean' condition. With a normal TOW of 16,065 kg (35,420 lb), the service ceiling was 16,000 m (52,490 ft). With a 13,230-kg (29,170-lb) all-up weight, including 3,710 kg (8,180 lb) of fuel, the *Firebar* had a range of 2,050 km (1,273 miles) and an endurance of 2 hrs 24 min at 11,000 m (39,370 ft). At 7,000 m (22,965 ft), range decreased to approximately 1,550 km (962 miles).

As an interceptor, the Yak-28P had an important asset in the form of provisions for JATO bottles permitting short takeoffs. In full afterburner and with JATO bottles the aircraft

Opposite: Three aspects of Yak-25M. The Yak-25 had a natural metal finish (note the variance in skin colours), the radome and the ventral fin usually being painted light grey.

The Yak-28P interceptor evolved from the Yak-27 supersonic interceptor, which did not enter production, and the Yak-28 tactical bomber.

This view illustrates the early production form of the Yak-28P with R11AF2-300 engines, a short ogival radome and two R-98 missiles.

would become airborne in about 400 m (1,310 ft); this and the *Firebar*'s high rate of climb enabled the fighter to close in on the target quickly.

A Yak-28PM carrying a load of red-painted inert missiles. Note the three 'kill' stars marking successful practice launches at real targets.

Yakovlev Yak-28PM interceptor (*izdeliye* 40, *Firebar*)

Attempts to improve the Yak-28P were not limited to engines; the Yakovlev OKB tried to refine the interceptor's aerodynamics in order to improve acceleration at speeds above Mach 1 throughout the altitude envelope. To this end the ogival radome *à la* Yak-27K was replaced with a longer radome of simple conical shape. This elicited some complaints from OKB-339, which feared that the new radome would spoil the radar's performance by generating unwanted reflections inside the radome, impairing the capabilities of the weapons system as a whole. Eventually, however, the airframers and the radar specialists managed to work out a compromise.

Secondly, the number of missiles was doubled by adding two R-3S IR-homing short-range AAMs. These were carried under the outer wings outboard of the R-8M-1s.

After passing state acceptance trials in 1966 the four-missile version entered production as the Yak-28P (*moderni**zee**rovannyy* – updated). Fully loaded, the aircraft had a 16,900-kg (37,260-lb) TOW, a top speed of 1,860 km/h (1,155 mph) and a service ceiling of 15,000 m (49,210 ft). It could destroy targets flying at 500-19,000 m (1,640-62,340 ft) and speeds up to 1,400 km/h (869 mph) at a distance of up to 600 km (372 miles).

The Yak-28PM saw service mainly in the northern regions of the Soviet Union. Thus, the 641st GvIAP based at Rogachovo AB on Novaya Zemlya Island flew the Yak-28PM until the mid-1980s when it re-equipped with the Su-27P.

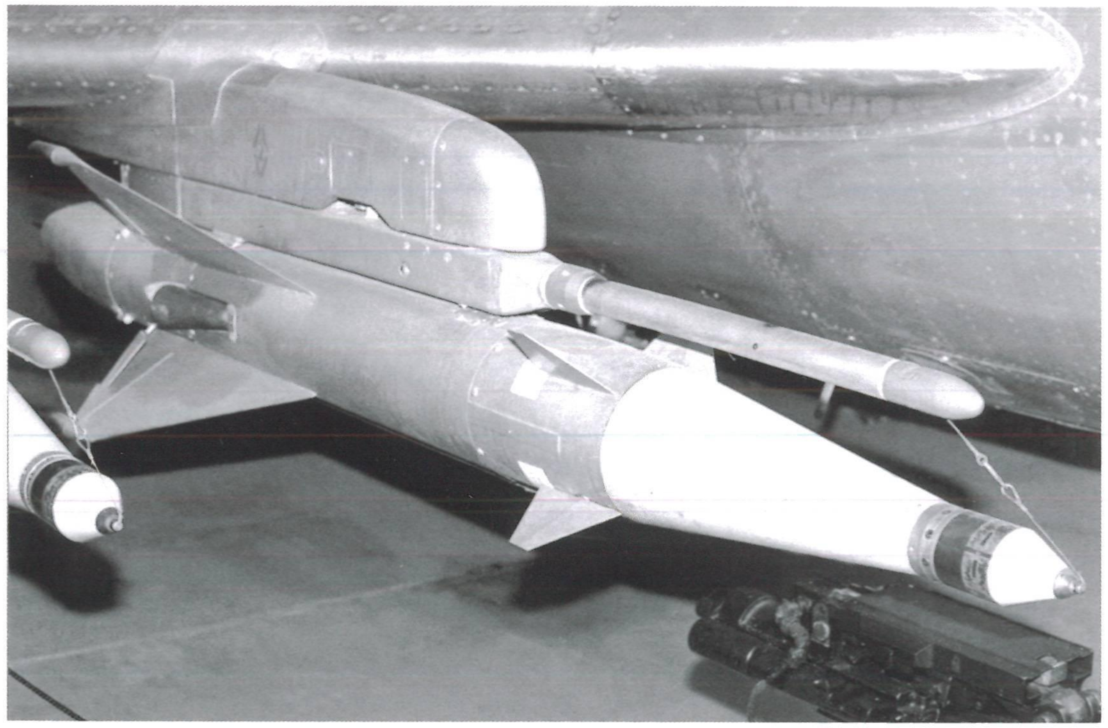
Missile armament

The air-to-air missiles forming the principal armament of the PVO's interceptors since the mid-1950s were products of several specialised design bureaux. One of them was OKB-2 headed by the well-known aircraft designer Pyotr D. Grooshin and established within the Ministry of Aircraft Industry framework on 26th November 1953. Grooshin's design team created the Soviet Union's first air-to-air missiles, the RS-1-U and RS-2-U; these were intended for use against aircraft lacking

Yakovlev interceptor specifications

	Yak-25	Yak-28P
Year of service entry	1955 [1]	1965 [1]
Powerplant	2 x AM-5A (RD-5A)	2 x R11AF2-300
Thrust, kgp (lbst):		
at full military power	2 x 2,000 (4,410)	2 x 3,900 (8,600)
in full afterburner	–	2 x 6,100 (2 x 13,450)
Length overall	15.665 m (51 ft 4 47/64 in)	20.55 m (67 ft 5 in) [2]
Height on ground	n.a.	4.3 m (14 ft 1 19/64 in)
Wing span	10.964 m (35 ft 11 21/32 in)	11.64 m (38 ft 2 17/64 in.)
Wing area, m² (sq ft)	28.95 (311.62)	35.25 (379.03)
Normal TOW, kg (lb)	10,045 (22,145)	16,400 (36,155)
Top speed at 12,000-13,000 m (39,370-42,650 ft), km/h (mph)	1,090 (677)	1,840 (1,142)
Service ceiling, m (ft)	12,000 (39,370)	16,000 (52,490)
Range, km (miles)	2,700 (1,677)	2,150 (1,162)
Endurance	3 hrs 26 min	2 hrs 31 min
Rate of climb, m/sec (ft/min)	44 (8,660)	n.a.
Take-off run with normal TOW, m (ft)	n.a.	1,430 (4,690)
Landing run, m (ft):		
without brake parachute	n.a.	1,250 (4,100)
with brake parachute	n.a.	710 (2,330)
G limit:		
normal	n.a.	5.0
maximum	n.a.	6.0
Armament	2 x N-37L cannons (37-mm) 50 (100) rpg	2 x R-8M-1 AAMs (2 x K-98 + 2 x R-3S AAMs [3])

1. Not officially on the inventory
2. Early-production short-nosed aircraft.
3. Yak-28PM



RS-2-U missiles on the pylons of a MiG-19PM. Note the longer conical nose and the RV-2-U proximity fuse with protective cap.

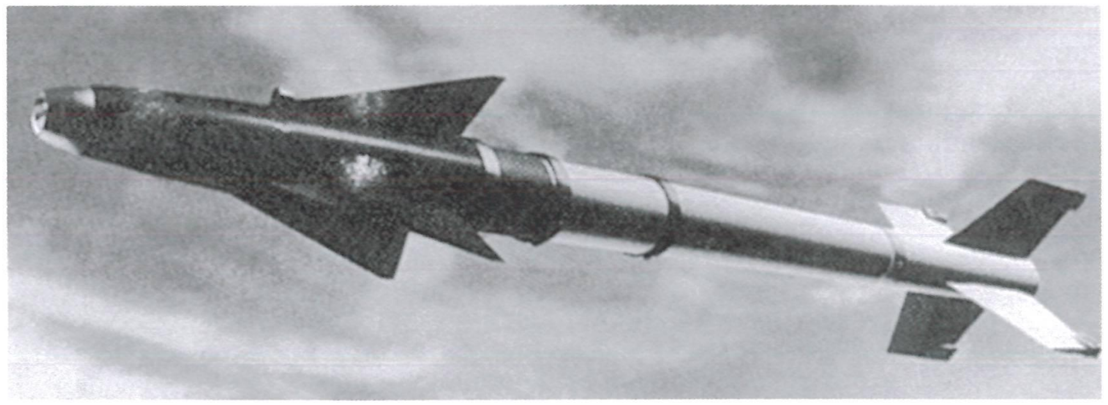
The specifications of OKB-2's missile family originating in the RS-1-U.

	RS-1-U (K-5)	RS-2-U (K-5M)	RS-2-US (K-5MS)	R-55
Designer	MKB Fakel	MKB Fakel	MKB Fakel	Zvezda OKB
Product code	*Izdeliye* 1	*Izdeliye* I	*Izdeliye* IS	*Izdeliye* 67
NATO reporting name	AA-1 *Alkali*	AA-1A *Alkali*	AA-1A *Alkali*	AA-1B *Alkali*
Service entry	1957	1958	1960	1972
Aerodynamic layout	Tail-first	Tail-first	Tail-first	Tail-first
Body diameter	200 mm (7⅞ in)	200 mm (7⅞ in)	200 mm (7⅞ in)	200 mm (7⅞ in)
Length overall	2.356 m (7 ft 8¾ in)	2.494 m (8 ft 2 3/16 in)	2.50 m (8 ft 2 7/16 in)	2.76 m (9 ft 0⅝ in)
Wing span	0.549 m (1 ft 9 39/64 in)	0.65 m (≈ 2 ft 1 19/32 in)	0.654 m (2 ft 1 19/32 in)	0.65 m (≈ 2 ft 1 19/32 in)
Roll stabilisation	Ailerons	Ailerons	Ailerons	Ailerons
Launch weight, kg (lb)	74.2 (163.5)	82.2 (181.2)	82.7 (182.3)	91.1 (200.8)
Warhead weight, kg (lb)	9.2 (20.28)	13.0 (28.66)	13.0 (28.66)	8.6 (18.96)
Warhead type	Fragmentation	Fragmentation	Fragmentation	Fragmentation
'Kill' range, km (miles)	2-3 (1.24-1.86)	2.5-3.5 (1.55-2.17)	2.5-3.5 (1.55-2.17)	1.2-2.8 (0.75-1.74)
Launch altitude, m (ft)	5,000-10,000 (16,400-32,810)	2,500-16,500 (8,200-54,130)	2,500-16,500/20,500 (8,200-54,130/67,260) [1]	0-22,000 (0-72,180)
Speed, m/sec (km/h; mph)	800 (2,880; 1,788)	800 (2,880; 1,788)	800 (2,880; 1,788)	800 (2,880; 1,788)
Guidance system	Radio command	Radio command	Radio command	IR homing
Seeker head type	–	–	–	S-59
Fuse type	RV-1-U radar proximity fuse	RV-2-U radar proximity fuse	RV-2-U radar proximity fuse	NOV-55 optical proximity fuse
Fuse detection radius	10 m (32 ft 9 in)	15 m (49 ft)	15 m (49 ft)	n.a.
Launch rail type	APU-3	APU-4	APU-4 APU-19, APU-20 APU-7	APU-68UM
Missile platform	MiG-17PFU MiG-19PM	MiG-19PM	MiG-19PM [2] Su-9 [2] MiG-21PFM [2]	Su-9 MiG-21*bis*

1. When carried by the MiG-19PM/Su-9 respectively
2. The aircraft are listed in the same order as their respective launch rails; on the Su-9, APU-19s are fitted to the inboard pylons and APU-20s to the outboard ones

in speed and agility, such as the Boeing B-50 Superfortress, Boeing B-52 Stratofortress and Convair B-36 Peacemaker bombers. In later years the OKB switched its efforts entirely to developing SAMs and anti-ballistic missiles (ABMs). In 1967 OKB-2 was renamed MKB *Fakel* ('Torch' Machinery Design Bureau; MKB = *mashinostroitel'noye konstrooktorskoye byuro*).

Later, OKB-455 headed by N. T. Pikot (the design office of plant No.455 manufacturing such AAMs as the RS-1-U, RS-2-US, R-8M and R-4) developed the R-55 air-to-air missile (a derivative of the RS-2-US) as a 'private venture' in the mid-1960s. In 1966 the design team was transformed into the *Zvezda* (Star) OKB, becoming the nation's leading specialist enterprise developing air-to-surface missiles.



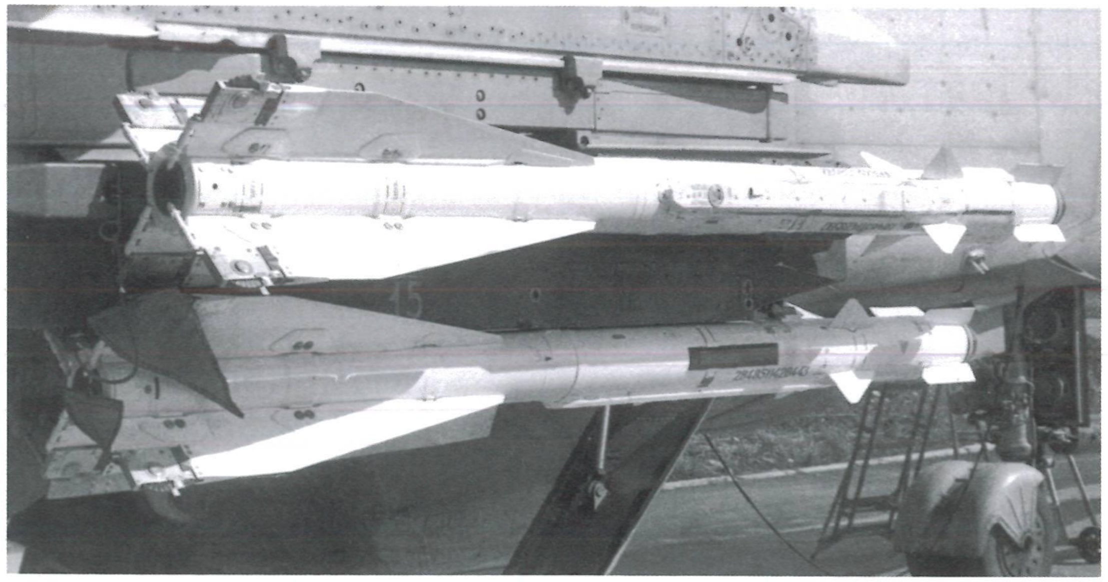
A drawing of the R-13M from a GMKB Vympel advertising leaflet.

The specifications of the short-range AAMs developed by the Bisnovat OKB (GMKB Vympel)

	R-3S (K-13)	R-3R (K-13R)	R-13M (K-13M)	R-60/R-60K (K-60)	R-60M/R-60MK	R-73
Designer	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel	MKB Molniya [1]
Product code	*Izdeliye* 310A	*Izdeliye* 320	*Izdeliye* 380	*Izdeliye* 62	*Izdeliye* 62M	*Izdeliye* 62
NATO reporting name	AA-2A *Atoll-A*	AA-2C *Atoll-C*	AA-2D *Atoll-D*	AA-8 *Aphid*	AA-8 *Aphid*	AA-11 *Archer*
Service entry	1960	1968	1972	1973	1975	1983
Aerodynamic layout	Tail-first	Tail-first	Tail-first	Tail-first	Tail-first	Tail-first
Roll stabilisation	Rollerons	Rollerons	Rollerons	Rollerons	Rollerons	Rollerons
Body diameter	127 mm (5 in)	127 mm (5 in)	127 mm (5 in)	120 mm (4 23/32 in)	120 mm (4 23/32 in)	170 mm (6 11/16 in)
Length overall	2.84 m (9 ft 3 13/16 in)	3.42 m (11 ft 2 41/64 in)	2.87 m (9 ft 5 in)	2.096 m (6 ft 10½ in)	2.14 m (7 ft 0¼ in)	2.9 m (9 ft 6 11/64 in)
Wing span	0.53 m (1 ft 8⅞ in)	0.53 m (1 ft 8⅞ in)	0.63 m (2 ft 0 13/32 in)	0.39 m (1 ft 3 11/32 in)	0.39 m (1 ft 3 11/32 in)	0.51 m (1 ft 8 in)
Launch weight, kg (lb)	75.3 (166.0)	82.4 (181.6)	88.2 (194.4)	43.5 (59.5)	45 (99.2)	105 kg (231.5 lb)
Warhead weight, kg (lb)	11.3 (24.9)	11.3 (24.9)	11.3 (24.9)	2.7 (18.96)	3.5 (7.72)	8 (17.6)
Warhead type	Fragmentation	Fragmentation	Continuous rod	Fragmentation	Continuous rod	Continuous rod
'Kill' range, km (miles)	1-3.6 (0.62-2.23)	1-3.6 (0.62-2.23)	0.9-4.0 (0.55-2.48)	0.25-1.0 (0.15-0.62)	0.2-1.0 (0.12-0.62)	0.3-30 (0.18-18.6)
'Kill' altitude, m (ft)	0-21,500 (0-70,540)	1,000-21,500 (3,280-70,540)	0-22,000 (0-72,180)	0-20,000 (0-65,615)	0-20,000 (0-65,615)	0-20,000 (0-65,615)
Speed, m/sec (km/h; mph)					(Mach 2.5)	
Guidance system	IR homing	SARH	IR homing	IR homing	IR homing	IR homing
Seeker head type	n.a.	n.a.	Iney-70, with liquid nitrogen cooling	Komar	Komar	Mayak
Fuse type	Optical proximity fuse	*Yastreb* radar proximity fuse	*Sinitsa* active proximity fuse	*Chizh* optical proximity fuse/*Kolibri* radar proximity fuse [2]	*Chizh* optical proximity fuse/*Kolibri* radar proximity fuse [2]	Radar proximity fuse
Fuse detection radius	9 m (29 ft)	n.a.	18 m (59 ft)	1-5 m (3 ft 3 in... 16 ft 5 in)	1-5 m (3 ft 3 in... 16 ft 5 in)	n.a.
Launch rail type	APU-13, APU-13U-1, APU-13MT	APU-13U-2	APU-13MT	APU-60-1, APU-60-2	APU-60-1, APU-60-2	APU-62-1M
Missile platform	MiG-21F-13, MiG-19P (mod), MiG-21PF to MiG-21*bis*, MiG-23S, MiG-23, MiG-23M	MiG-21S to MiG-21*bis*, MiG-23S, MiG-23	MiG-21SM to MiG-21*bis*, MiG-23, MiG-23M	MiG-21*bis*, MiG-23M to MiG-23MLD, MiG-25PD, Su-15TM	MiG-21SM to MiG-21*bis*, MiG-23M to MiG-23MLD, MiG-25PD, MiG-31, Su-15TM, Yak-28PM	Su-27P

1. Development completed by GMKB Vympel

2. R-60K and R-60MK respectively



A view of two R-60Ms on an APU-60-2 dual launcher. The ventral conduit of the outboard missile is clearly visible here, as are the rollerons on the trailing edges of the fins.

The specifications of some of the Bisnovat OKB's medium-range missiles

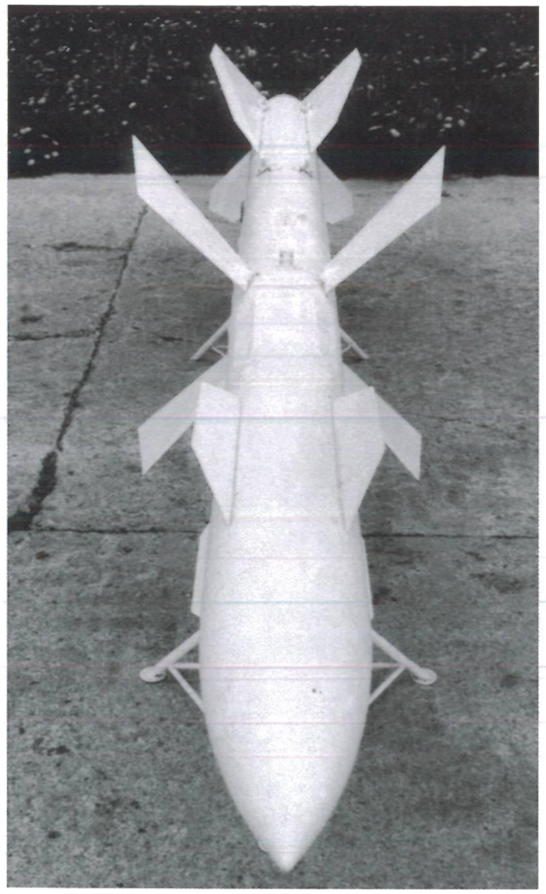
	R-8MR	R-8MT	R-98R	R-98MT	R-23R	R-23T	R-24R	R-24T
Designer	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel
Product code	*Izdeliye* 24R	*Izdeliye* 24T	*Izdeliye* 56R	*Izdeliye* 57T	*Izdeliye* 340	*Izdeliye* 360	*Izdeliye* 140	*Izdeliye* 160
NATO codename	AA-3 *Anab*	AA-3 *Anab*	AA-3-2 *Advanced Anab*	AA-3-2 *Advanced Anab*	AA-7A *Apex*	AA-7B Apex	AA-7A *Apex*	AA-7B *Apex*
Service entry	1961	1961	1967	1972	1970	1970	1981	1981
Aerodynamic layout	Tail-first	Tail-first	Tail-first	Tail-first	Conventional	Conventional	Conventional	Conventional
Roll stabilisation	Ailerons	Ailerons	Ailerons	Ailerons				
Body diameter	275 mm (10 53/64 in)	275 mm (10 53/64 in)	275 mm (10 53/64 in)	275 mm (10 53/64 in)	200 mm (7⅞ in)	200 mm (7⅞ in)	200 mm (7⅞ in)	200 mm (7⅞ in)
Length overall	4.18 m (13 ft 8 9/16 in)	4.0 m (13 ft 1 31/64 in)	4.26 m (13 ft 11 23/32 in)	4.14 m (13 ft 7 in)	4.46 m (14 ft 7 19/32 in)	4.16 m (13 ft 7¾ in)	4.487 m (14 ft 8 21/32 in)	4.194 m (13 ft 9 7/64 in)
Wing span	1.22 m (4 ft 0 in)	1.22 m (4 ft 0 in)	1.22 m (4 ft 0 in)	1.22 m (4 ft 0 in)	1.0 m (3 ft 3⅜ in)	1.0 m (3 ft 3⅜ in)	1.0 m (3 ft 3⅜ in)	1.0 m (3 ft 3⅜ in)
Launch weight, kg (lb)	275 (606.25)	227 (500.4)	275 (606.25)	227 (500.4)	223 (491)	216 (476)	243 (535)	235 (518)
Warhead weight, kg (lb)	40 (88)	40 (88)	40 (88)	40 (88)	25 (55)	25 (55)	35 (77)	35 (77)
Warhead type	High-explosive	High-explosive	High-explosive	High-explosive	Continuous rod/ fragmentation	Continuous rod/ fragmentation	Continuous rod	Continuous rod
'Kill' range, km (miles)	2-12 (1.24-7.45)	2-12 (1.24-7.45)	2-24 (1.24-14.9)	2-16 (1.24-9.9)	2.5-27 (1.5-16.75)	3-15 (1.86-9.3)	0.5-50 (0.31-31)	0.5-35 (0.31-21.75)
'Kill' altitude, m (ft)	5,000-23,000 (16,400-75,460)	5,000-23,000 (16,400-75,460)	5,000-23,000 (16,400-75,460)	500-24,000 (1,640-78,740)	0-25,000 (0-82,020)	0-25,000 (0-82,020)	40-25,000 (130-82,020)	40-25,000 (130-82,020)
Guidance system	SARH	IR homing	SARH	IR homing	SARH	IR homing	SARH	IR homing
Seeker head type	PARG-16	TGS-14	n.a.	TGS-14T	n.a.	TGS-23	RGS-24	TGS-23T4
Fuse type	*Aïst-24* radar proximity fuse	*Aïst-24* radar proximity fuse	n.a.	n.a.	*Chaika* radar proximity fuse	*Chaika* radar proximity fuse	*Skvorets* radar proximity fuse	*Skvorets* radar proximity fuse
Rocket motor type	PRD-141	PRD-141	PRD-143	PRD-143	PRD-194	PRD-194	PRD-287	PRD-287
Launch rail type	PU-1-8	PU-1-8	PU-2-8	PU-2-8	APU-23-11, APU-23M	APU-23-11, APU-23M	APU-23M1	APU-23M1
Missile platform	Su-11, Su-15, Yak-28P	Su-11, Su-15, Yak-28P	Su-15, Su-15T	Su-15 (mod), Su-15TM	MiG-23, MiG-23M	MiG-23, MiG-23M	MiG-23ML	MiG-23ML

A radar-homing R-8MR missile. Note the flush aerial of the radio proximity fuse and the deflection of the rudder pairs to create yaw to the right.

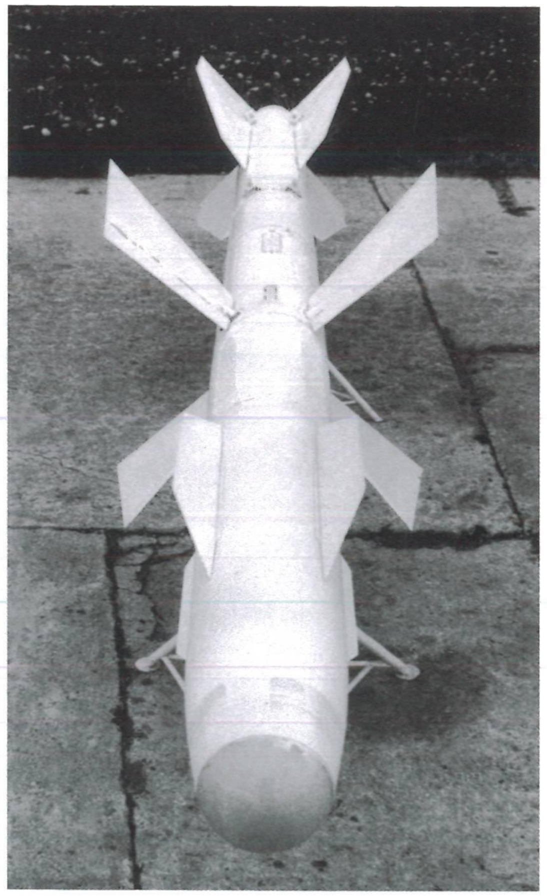
The specifications of some of the Bisnovat OKB's medium-range missiles (continued)

	R-27R	R-27T	R-27RE	R-27TE
Designer	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel
Product code	*Izdeliye* 470	*Izdeliye* 470	*Izdeliye* 470	*Izdeliye* 470
NATO codename	AA-10A *Alamo-A*	AA-10B *Alamo-B*	AA-10C *Alamo-C*	AA-10D *Alamo-D*
Service entry	1983	1983	1983	1983
Aerodynamic layout	Tail-first	Tail-first	Tail-first	Tail-first
Body diameter	230 mm (9 in)	230 mm (9 in)	260 mm (10 15/64 in)	260 mm (10 15/64 in)
Length overall	4.08 m (13 ft 4⅝ in)	3.795 m (12 ft 5 13/32 in)	4.78 m (15 ft 8 3/16 in)	4.5 m (14 ft 9 5/32 in)
Wing span	0.772 m (2 ft 6 25/64 in)	0.772 m (2 ft 6 25/64 in)	0.8 m (2 ft 7½ in)	0.8 m (2 ft 7½ in)
Launch weight, kg (lb)	253 (557)	254 (560)	350 (771)	343 (756)
Warhead weight, kg (lb)	39 (86)	39 (86)	39 (86)	39 (86)
Warhead type	Continuous rod	Continuous rod	Continuous rod	Continuous rod
'Kill' range, km (miles)	0.2-80 (0.12-49.6)	0.2-70 (0.12-43.5)	0.2-130 (0.12-80.7)	0.2-120 (0.12-74.5)
'Kill' altitude, m (ft)	20-25,000 (65-82,020)	20-25,000 (65-82,020)	n.a.	n.a.
Guidance system	SARH + inertial with mid-course guidance	IR homing + inertial with mid-course guidance	SARH + inertial with mid-course guidance	IR homing + inertial with mid-course guidance
Seeker head type	9B-1101K	All-aspect IR seeker head	9B-1101K	All-aspect IR seeker head
Fuse type	radar proximity fuse	radar proximity fuse	radar proximity fuse	radar proximity fuse
Target maximum speed, km/h (mph)	3,500 (2,174)	3,500 (2,174)	3,500 (2,174)	3,500 (2,174)
Missile speed	Mach 4.5	Mach 4.5	Mach 4.5	Mach 4.5
Launch rail type	AKU-470	APU-470	AKU-470	APU-470
Missile platform	Su-27 [1]	Su-27	Su-27	Su-27

1. The R-27 is carried by other types as well but only Soviet-era PVO types are listed here.



This view of the R-27R shows the constant body diameter of the standard ('short-burn') version and the trapezoidal fixed destabilisers ahead of the reverse-tapered rudders.

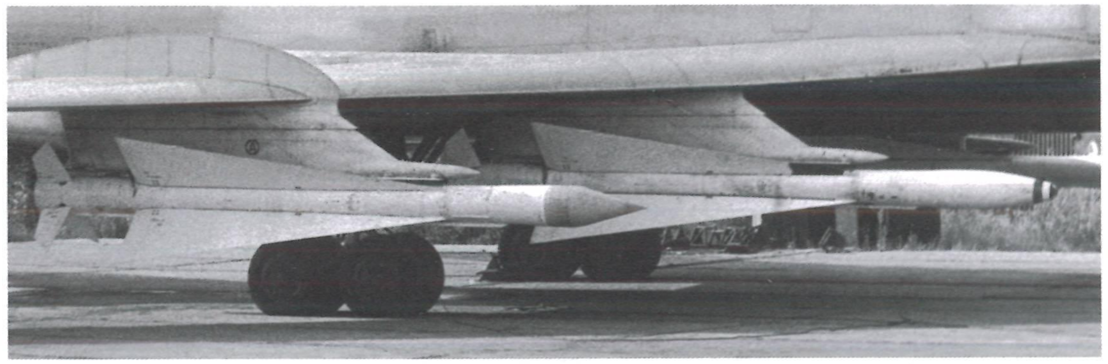


A view of the R-27T, showing the hemispherical nose of the IR seeker head.

The specifications of some of the Bisnovat OKB's medium-range missiles (continued)

	R-4R	R-4T (R-4TI)	R-4RM	R-4TM
Designer	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel
Product code	*Izdeliye* 36R	*Izdeliye* 36T (*izdeliye* 36TI)	*Izdeliye* 36RM	*Izdeliye* 36TM
NATO codename	AA-5 *Ash*	AA-5 *Ash*	AA-5A *Ash*	AA-5A *Ash*
Service entry	1965	1965	1975	1975
Aerodynamic layout	Conventional	Conventional	Conventional	Conventional
Body diameter	340 mm (1 ft 1 25/64 in)	343 mm (1 ft 1½ in)	340 mm (1 ft 1 25/64 in)	340 mm (1 ft 1 25/64 in)
Length overall	5.53 m (18 ft 1 23/32 in)	5.36 m/5.48 m [1] (17 ft 11¾ in [1])	5.53 m (18 ft 1 23/32 in)	5.57 m (18 ft 3 19/64 in)
Wing span	1.55 m (5 ft 1 1/64 in)	1.55 m (5 ft 1 1/64 in)	1.55 m (5 ft 1 1/64 in)	1.55 m (5 ft 1 1/64 in)
Launch weight, kg (lb)	492 (1,084)	480/497 [1] (1,058/1,095 [1])	512.5 (1,129)	502 (1,106)
Warhead weight, kg (lb)	53.6 (118.17)	53.6 (118.17)	53.6 (118.17)	53.6 (118.17)
'Kill' range, km (miles)	2-16 (1.24-9.94)	2-15 (1.24-9.3)	2-30 (1.24-18.6)	2-30 (1.24-18.6)
'Kill' altitude, m (ft)	8,000-21,000 (26,250-68,900)	8,000-21,000 (26,250-68,900)	8,000-21,000 (26,250-68,900)	8,000-21,000 (26,250-68,900)
Speed, m/sec (km/h; mph)	1,000 (3,600; 2,236)	1,000 (3,600; 2,236)	1,000 (3,600; 2,236)	1,000 (3,600; 2,236)
Target maximum speed, km/h (mph)	2,000 (1,240)	2,000 (1,240)	2,000 (1,240)	2,000 (1,240)
Guidance system	SARH	IR homing	SARH	IR homing
Seeker head type	PARG-10VV	T-80NM Roobezh	PARG-15VV	T-80NMD
Fuse type	RV-80 radar proximity fuse	RV-80 radar proximity fuse/ optical proximity fuse [1]	RV-80 radar proximity fuse	combined radar/optical proximity fuse
Rocket motor type	PRD-84	PRD-84	PRD-84M	PRD-84M
Missile platform	Tu-128, Tu-128M	Tu-128, Tu-128M	Tu-128M	Tu-128M

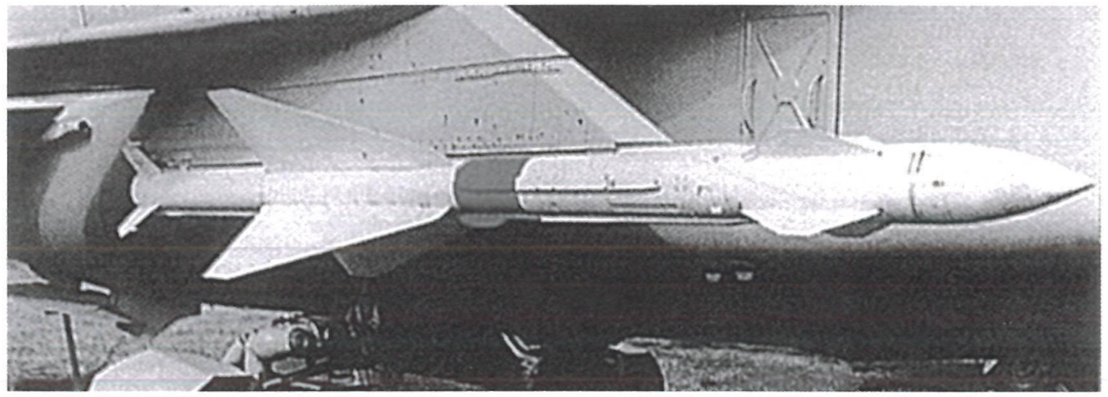
1. The data applies to the R-4TI.



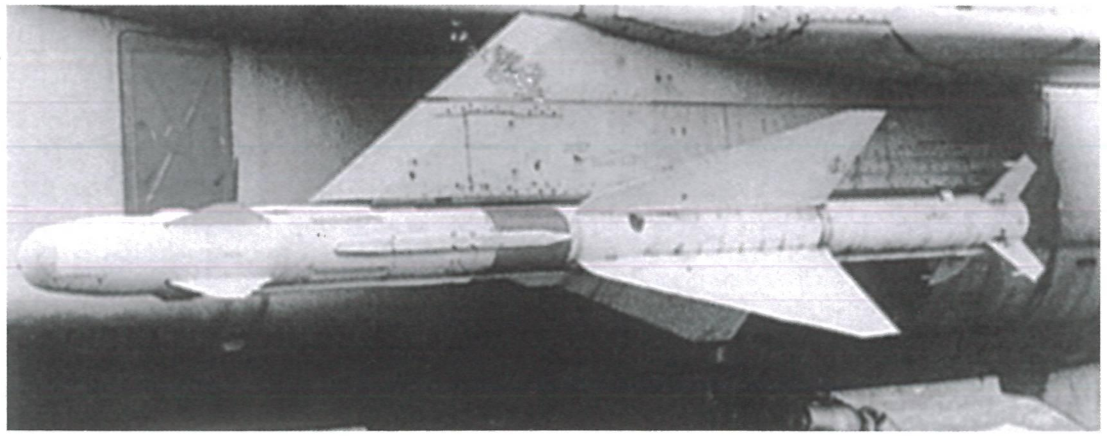
The Tu-128 carried IR-homing R-4T missiles on the inboard pylons and semi-active radar-homing R-4Rs outboard.

The specifications of the long-range AAMs developed by GMKB Vympel	R-40R (K-40)	R-40T (K-40)	R-40RD (K-40D)	R-40TD (K-40D)	R-33 (K-33)
Designer	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel	GMKB Vympel
Product code	*Izdeliye* 46R	*Izdeliye* 46T			*Izdeliye* 410
NATO codename	AA-6 *Acrid*	AA-6 *Acrid*	AA-6 *Acrid*	AA-6 *Acrid*	AA-9 *Amos*
Service entry	1970	1970	1979	1979	1981
Aerodynamic layout	Tail-first	Tail-first	Tail-first	Tail-first	Conventional
Roll stabilisation	Ailerons	Ailerons	Ailerons	Ailerons	
Body diameter	300 mm (11 13/16 in)	300 mm (11 13/16 in)	300 mm (11 13/16 in)	300 mm (11 13/16 in)	380 mm (1 ft 2 31/32 in)
Length overall	6.376 m (20 ft 11 1/64 in)	5.98 m (19 ft 7 7/16 in)	6.231 m (20 ft 5 5/16 in)	5.98 m (19 ft 7 7/16 in)	4.15 m (13 ft 7 25/64 in)
Wing span	1.45 m (4 ft 9 5/16 in)	1.45 m (4 ft 9 5/16 in)	1.45 m (4 ft 9 5/16 in)	1.45 m (4 ft 9 5/16 in)	0.9 m (2 ft 11 13/32 in) [1]
Launch weight, kg (lb)	455 (1,003)	468 (1,031)	461 (1,016)	467 (1,029)	490 (1,080)
Warhead weight, kg (lb)	38 (83)	38 (83)	38 (83)	38 (83)	47 (103)
Warhead type	High-explosive	High-explosive	High-explosive	High-explosive	HE/fragmentation
'Kill' range, km (miles)	2-30 (1.24-18.6)	2-36 (1.24-22.3)	2-36 (1.24-22.3)	2-36 (1.24-22.3)	120 (74.5)
'Kill' altitude, m (ft)	2,500-27,000 (8,200-88,580)	800-30,000 (2,620-98,425)	2,500-27,000 (8,200-88,580)	800-30,000 (2,620-98,425)	25-28,000 (80-91,860)
Guidance system	SARH	IR homing	SARH	IR homing	SARH + inertial with mid-course guidance
Seeker head type	PARG-12	T-40A1	RGS-25	35T1	n.a.
Fuse type	*Aïst-M* radar/optical proximity fuse	*Aïst-M* radar/optical proximity fuse	*Aïst-M* radar/optical proximity fuse	*Aïst-M* radar/optical proximity fuse	Radar proximity fuse
Launch rail type	APU-84-46	APU-84-46	APU-84-46	APU-84-46	AKU-410-1
Missile platform	MiG-25P, MiG-31	MiG-25P, MiG-31	MiG-25PD, MiG-25PDS, MiG-31	MiG-25PD, MiG-25PDS, MiG-31	MiG-31

1. The rudder span is quoted variously as 1.11 m or 1.18 m (3 ft 7 45/64 in or 3 ft 10 29/64 in).



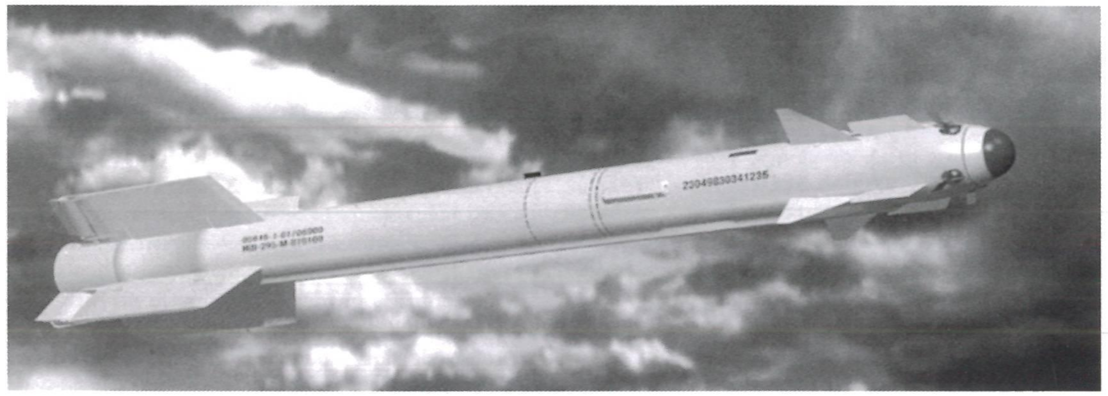
A radar-homing R-23R with the ogival version of the radome on the an APU-23-11 launch rail fitted to the starboard wing glove pylon of a MiG-23 *sans suffixe*.



An IR-homing R-23T on the port wing glove pylon of the same aircraft. A mix of radar-homing and IR-homing missiles was usually carried to maximise the 'kill' probability.

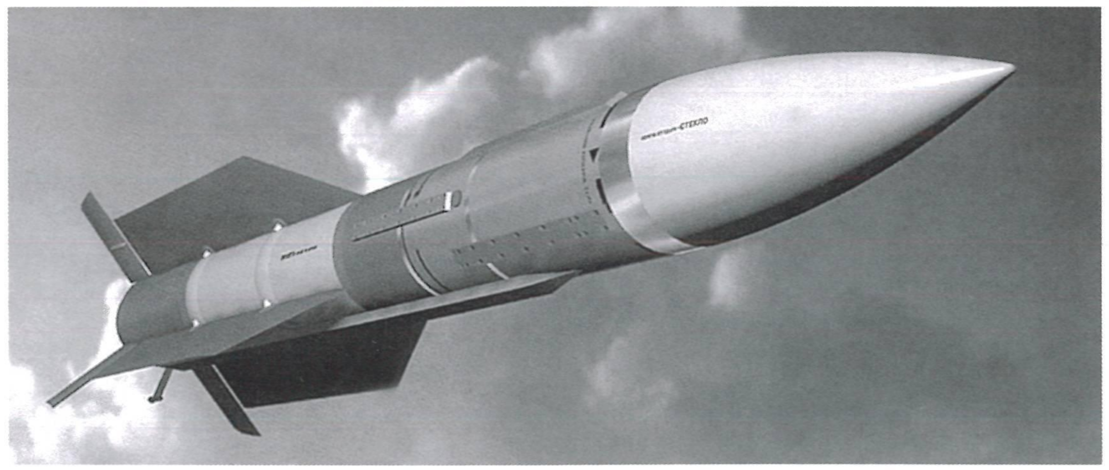
Established in 1948, OKB-293 headed by Matus R. Bisnovat (an aircraft designer whose career began in the early 1930s) originally developed missiles in the surface-to-surface and air-to-surface classes. In 1954 the Bisnovat OKB was renumbered, becoming OKB-4; its main specialisation was now AAMs of all classes (short-range, medium-range and long-range). In 1967 the OKB changed its name again to become GMKB *Vympel* ('Pennant' State Machinery Design Bureau; GMKB = *gosu**dar**stvennoye ma**shin**ostro**it**el'noye kon-**strook**torskoye by**uro***).

The basic specifications of the missiles developed by these design bureaux and used by the interceptors in service the the PVO Aviation are given in the tables on the preceeding pages.

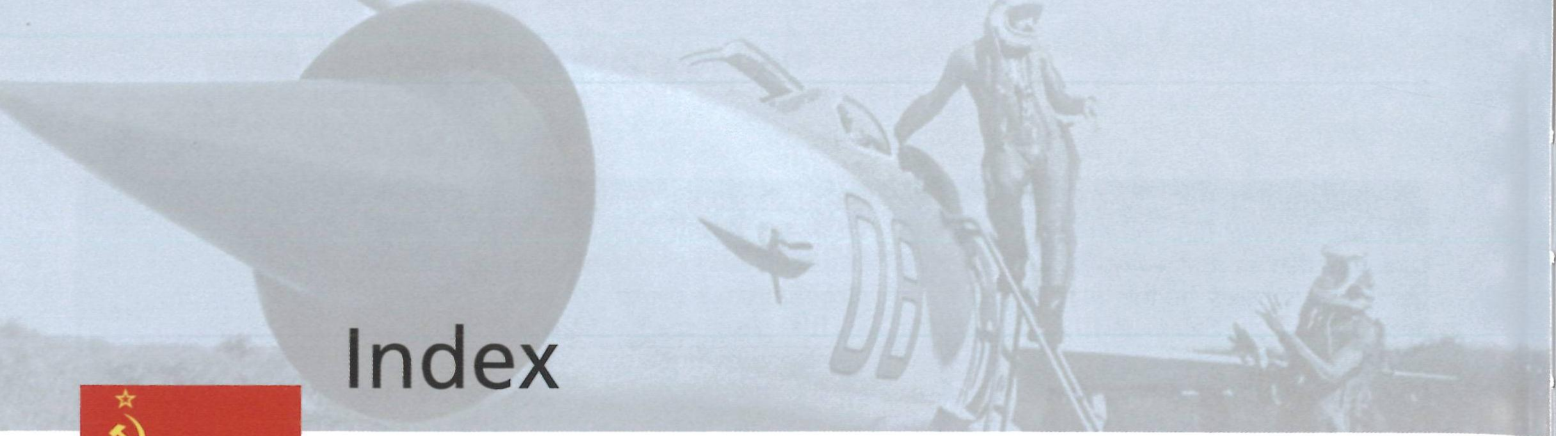


The R-73 short-range AAM is strongly reminiscent of the earlier R-60M but has a different fin shape and very characteristic pitch/yaw vanes immediately ahead of the destabilisers.

An R-40TD on display at one of the Moscow airshows. Note the red-painted ailerons. The faired lateral nozzles are not visible in this view.



A picture of the R-33 from a GMKB Vympel advertising brochure, showing the strake-like fins and the folding upper pair of rudders.



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ALSO BY YEFIM GORDON AND DMITRIY KOMISSAROV

Russian Strategic Aviation Today

In 1991 the Russian Air Force's strategic bomber component inherited aircraft from the Soviet Air Force after the disintegration of the Soviet Union.

Recovering some of the heavy bomber assets left outside its borders, Russia began its fleet by obtaining Tu-95MS Bears based in Kazakhstan and saving part of the bomber fleet taken over by the Ukraine including eight Tu-160 Blackjacks from the breaker's torch.

Russia's present-day strategic bomber force relies on these aircraft types, plus the Tu-22M3 Backfire-C, all originating from the famous Tupolev design bureau.

The development history and design of the aircraft is briefly explained and numerous photographs illustrate the Russian Air Force's strategic bomber arm in action. The 37th Air Army was responsible for operating these aircraft and its order of battle and bases are described, including recent exercises and its involvement in the brief military operation to halt the Georgian aggression against South Ossetia in August 2008. Details of the latest reorganisation of the now defunct 37th Air Army are complemented by information on long-range aviation's switch from regiments to air bases as operational units.

In addition to over 500 photographs, many previously unreleased, the book features 40 unit badges and insignia of the Russian strategic bomber units operating the Blackjack, Bear and Backfire.

Close-up photographs, detailed line drawings and over 100 colour profiles bearing individual names and nose art provide a mass of comprehensive information on the men and their machines for the aviation enthusiast or historian.

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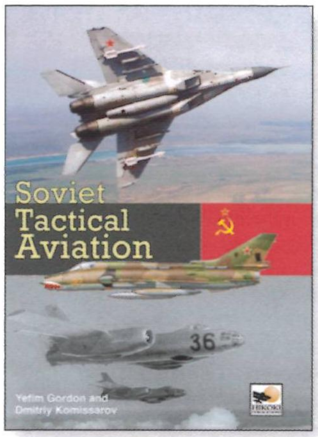

Soviet Tactical Aviation

The 1950s and the 1970s can justifiably be regarded as the golden age of the Soviet Tactical Aviation. The development of supersonic aircraft armed with cannons, missiles and bombs and equipped with powerful radars allowed the tactical aviation arm of the Soviet Air Force to operate in all weather conditions and round the clock, intercepting high-speed aerial targets at long range, providing close air support for own troops on the battlefield, detecting and destroying small mobile targets, attacking enemy air and ground assets and conducting aerial reconnaissance.

Being at the forefront of the Cold War between the Warsaw Pact and the NATO alliance, Soviet Tactical Aviation units were permanently stationed in Eastern Europe, but their first post-WWII experience of actual combat came in the Korean War in 1950. Fighting alongside the Joint Chinese/North Korean Air Army, they fought bitter battles against the US-led United Nations coalition forces, sustaining and inflicting heavy losses. The 1960s, 1970s and 1980s brought other conflicts as the Soviet Union extended military assistance to nations within its sphere of influence such as Eastern Europe and Mongolia, as well as places such as Cuba, the Middle East and the extreme conditions of Afghanistan which claimed the lives of so many Soviet pilots.

With over 500 photographs and colour profiles, combined with the detailed history of units, aircraft, operations and insignia, Soviet Tactical Aviation offers a unique in-depth record of this pivotal era in Soviet military aviation history.

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Soviet and Russian Testbed Aircraft

In both Soviet and modern Russia a multitude of assorted aircraft have been used for test and research purposes – primarily for verifying new avionics, systems and weaponry.

The use of systems being tested was not limited to aviation as aircraft were also utilised for other purposes including testing components of ballistic missile systems. All categories of test and research aircraft are examined including: engine testbeds such as the Il-76LL and Tu-16LL, radar testbeds like the SL-18P based on the well-known Il-18 airliner, electronic warfare system testbeds, and those used for weapons testing including the G-310. From landing gear, Su-29KS and An-12MLL ejection seats, refuelling systems and helicopters modified as rotor systems testbeds to civil aircraft including the An-12BPTs 'Tsiklon' weather research aircraft and IMARK geophysical survey aircraft. The MiG-27LL and MiG-29KVP aircraft used for testing conventional take-off and landing technologies during the Soviet CTOL aircraft carrier development programme are also examined.

Comprehensive details of each aircraft are coupled with information on the test centres from which these testbeds operate including the M. M. Gromov Flight Research Institute in Zhukovskiy, and the Air Force's 929th State Flight Test Centre in Akhtoobinsk.

Over 700 photographs, 72 line drawings, close-up views of tell-tale 'bumps and bulges' and more than 100 new colour profiles illustrate the aircraft and provide a wealth of information for the aviation historian, enthusiast and modeller alike.

ISBN: 9 781902 109183
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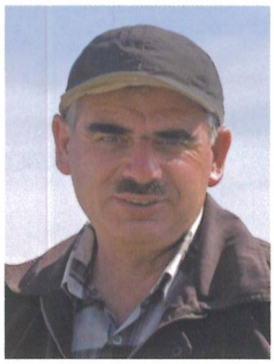
Price £34.95

Dmitriy Komissarov was born in 1968 in Moscow and graduated from the Moscow State Linguistics University in 1992. He has worked as a translator ever since, with most of his work associated with his interest in aviation.

Dmitriy Komissarov has authored two books and translated or co-authored more than 50 others. He has also written numerous magazine features in two languages on Soviet and Russian aviation. Dmitriy currently works for the Moscow based publishing house Polygon Press Ltd and is contactable at sdkom@inbox.ru



Yefim Gordon was born in 1950 in Vilnius, Lithuania (then part of the Soviet Union) and graduated from the Kaunas Polytechnic Institute in 1972. He has been researching Soviet and Russian aviation history for more than 40 years and has collected one of the world's largest photograph and document archives on the subject.

A professional aviation journalist and photographer since 1989 Yefim Gordon has published hundreds of features and photographs in Soviet, Russian and foreign aviation magazines. He has also authored and co-authored more than 100 books on Soviet and Russian aviation which are published in seven countries. Currently Yefim is Executive Director of the Moscow-based aviation publishing house Polygon Press Ltd and is contactable at yefimair@gmail.com.

HIKOKI
PUBLICATIONS

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Following the cessation of hostilities in the years immediately after the Second World War the Soviet Union re-organised its Air Defence Force (PVO – *Protivovozdooshnaya oborona*) into aircraft spotting, alerting and communications units, anti-aircraft artillery, searchlight units and fighter aviation. Further organised into divisions, corps and armies their order of battle depended on the specific tasks each formation was facing and was extended in the post-war years to include the protection of coastal areas and Soviet Navy bases. Special Anti-Missile Defence/Space Defence Forces were also established in keeping with a General Staff directive issued on 30th March 1967.

The primary function of the PVO's fighter branch (IA PVO) was the interception and destruction of hostile aircraft and unmanned aerial vehicles which they achieved with their altered avionics, ground controlled intercept systems and air-to-air weapons.

Beginning with Mikoyan/Gurevich MiG-15*bis Fagot-B* and MiG-17F *Fresco-C* jet fighters, the IA PVO continued its defence with specialised all-weather interceptors including the MiG-17PF *Fresco-D*, and MiG-17PFU *Fresco-E*, which traded the cannons for air-to-air missiles.

The supersonic MiG-19PM *Farmer-D* (missile-armed) as well as the Yakovlev Yak-25/Yak-25M *Flashlight-A* interceptor soon followed and, in subsequent years the IA PVO operated specialised supersonic interceptors including the Sukhoi Su-9 *Fishpot-A*, Yak-28P *Firebar*, Tupolev Tu-128 *Fiddler*, and MiG-31 *Foxhound*.

Details of all Soviet interceptors combine with the IA PVO's order of battle, over 400 photographs, 50 colour profiles and accounts of specific intercepts and incidents to provide a unique insight into this period of Soviet history.

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